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ADDRESS AT THE ANNIVERSARY GENERAL MEETING, 29 MAY 1922

Lt.-Col. Sir Francis Younghusband, K.C.S.I., K.C.I.E., President

THE chief event during the past year, so far as our Society is concerned, has been the return of the Mount Everest Expedition from its reconnaissance of the mountain. As Fellows are aware, it was not our intention last year to make any definite attempt to climb the mountain. So little was known about it that all we expected of the Expedition was that they should thoroughly reconnoitre the approaches and determine the easiest line of assault on the summit. This the Expedition, under Colonel Howard-Bury's fine leadership and through Messrs. Mallory and Bullock's fine mountain craft, were able to settle beyond dispute. No one doubts that the easiest and indeed only possible way to the top of Mount Everest is by the East Rongbuk glacier to Chang-La (the North Col) and from there by a climb of 6000 feet up the ridge which runs out from the summit in a north-easterly direction.

But besides having achieved its main object so definitely the Expedition were also able to accomplish much other work of value. The officers of the Survey of India who accompanied the Expedition, Major H. T. Morshead, D.S.O., and Major E. O. Wheeler, M.C., were able to carry out a general survey of the whole unmapped area covered by the Expedition, on a scale of 1 inch to 4 miles; and a detailed survey of the immediate environs of Mount Everest on a scale 1 inch to 1 mile. Dr. A. M. Heron of the Geological Survey of India was able to make a geological reconnaissance of the area and traverse and map it (geologically) on a scale of $\frac{1}{4}$ inch to the mile. Mr. A. F. R. Wollaston was able to make a valuable collection of the mammals, birds, and plants, and to make notes of the natural history of the region. And Colonel Howard-Bury, Mr. Wollaston, and Major Wheeler brought back particularly beautiful and interesting photographs. This Society, and I am sure I may speak for the Alpine Club also, are highly indebted to these gentlemen not only for their strenuous work in the field but for the despatch with which they have put on paper the results of that work, so that we have been able, in less than a year from the date on which the Expedition started, to present to the public a book

containing a detailed account of the Expedition with maps and illustrations complete. This year's Expedition thereby has at its disposal the full results of last year's Expedition, and the public is enabled to follow its progress with full information to hand.

Last year, as I have said, a reconnaissance was made. But this year, with every resource we have been able to command, a full-blown effort will be made to reach the summit. The Expedition which left Darjeeling at the end of March and which by now must be actually on the mountain, has the benefit of the experience and knowledge gained last year, and is by far the best equipped expedition which has ever been sent either to the Himalaya or any other mountain range. It has been able to start earlier than the Expedition last year, and so has the most favourable season—May and June—at its disposal. And every member has arrived at the mountain in good health. All this is to the good. And what is also to the good is the circumstance that so far as the configuration of the mountain is concerned there are no serious obstacles to oppose the climbers. But with these numerous advantages there still remains that incalculable factor which may prove fatal to success, namely, the debilitating effect of high altitudes upon the human constitution. We have sent out the hardiest, pluckiest, and most skilful and experienced mountaineers we can find. But can they, with all their hardihood, all their courage, and all their determination, skill, and resource, successfully contend against the paralyzing lassitude which the rarefaction of the air beyond 23,000 feet is certain to produce? Experience—the experience of these next few weeks—alone can determine. The weakness is occasioned by the lessening quantity of oxygen in the thinning atmosphere. And to make up for this want of oxygen we have sent out special apparatus for supplying the precious gas. But even this may not avail, for the apparatus is heavy, and of necessity the climbers themselves must carry it. And no one can say whether the advantage of breathing the oxygen will outweigh the drawback of having to carry the apparatus.

How we will view the prospect of success depends upon the varying temperaments of different individuals. Some men, when once they are embarked upon an expedition, never allow themselves to suppose for a moment that it is going to be anything else but an unqualified success. Difficulties and dangers they know they will meet with, but the contemplation of this prospect only exhilarates them. Other men take these certainties more seriously. They weigh the chances of success with cool deliberation, and seem to take unholy delight in summing up the chances of success against themselves. There are men of both types in every expedition. Certainly there are in the Mount Everest Expedition. And perhaps it is well; for the one serves to spur on the other. But for us onlookers, who have none of the brunt and burden and danger of the expedition, there is only one attitude to adopt. It is not for us to assume as a matter of course that the climbers will reach the top. We

have done our best to provide them with every condition of success that it was in our power to provide. But with every condition favourable the task may be beyond human capacity. And all we can with propriety do is to express our confidence in the climbers that all that is humanly possible they will do.

Leaving it at that, let me bring you back from the far side of the Himalaya here to London itself. One of the best papers which were read to us this season was on London. And this suggests to my mind—and I should like to pass the suggestion on to your minds—that here close at hand may be a fascinating field for future geographical enterprise. The poet asks, "What do they know of England who only England know?" And I should reply that neither those who only England know nor those who know other parts of the Empire and of the world as well know anything like as much as we ought to know of England—even from our own special point of geography alone. We send out explorers to the ends of the Earth and we shall always continue to send them to explore every sort of out-of-the-way region. But the time has arrived for the emergence of a new type of explorers—what we may call home-explorers—men and women who will explore, observe, and describe their own homeland, whether that homeland be England or Scotland, Canada or India, France or Italy. The spade-work for this intensified form of exploration has now been completed. The geographical features have been depicted on maps and in photographs. Geological surveys have been made. The fauna and flora have been catalogued. Guide-books have been compiled. All the means for his work are there ready to hand for the intensive home-explorer. And by the use of these means he should be able now to present us with such a picture of his homeland as to make us feel we really knew it—knew what it was like.

Our novelists are moving in this direction, and Thomas Hardy and Maurice Hewlett are making Wessex and Sussex known to us. And last year I tried to entice Maurice Hewlett into our fold by inviting him to our annual repast. But he was too fond of his own special homeland to be caught by any such simple manœuvre. So we must think of some more cunning device to lure him and his like till we gather to us men with eyes to see, and hearts to feel, and heads to think, who will be fired with enthusiasm to explore round about their own homes, and then come here and describe to us what they have seen.

These home-explorers need not have a motor-car, nor even a motor-cycle or bicycle. They need not even have youth. What they will have to do will be much better done on foot, and by men of sixty or seventy perhaps better than by men of twenty or thirty. Nor need they be trained surveyors or expert naturalists. For they will have maps already to hand for purposes of measurement and to show the configuration of the land.

And as for the natural history, if they see a bird with black plumage and a yellow beak, all they will have to do is to look it up in a bird book, and they will find at once that it is a blackbird; and if they see a pale yellow flower growing on a single stalk surrounded by pale green leaves, all they will have to do is to look it up in a plant book, and they will find it is a primrose. The bare facts about the outward appearance of a country are very easily obtained, and the home-explorer need be no specialist to amass them. He has no need therefore for any of these qualifications. But what is absolutely necessary and what he cannot do without is the power to *understand* a country, the faculty of being able to seize its essential characteristics and, discarding unimportant details, of bringing those essential characters together in a connected whole till we have a clear and definite impression which will readily implant itself upon our minds. It may be an impression of a green and pleasant land or of a brown and barren desert; of loveliness and charm or of austerity and grandeur; of sweetness or of sternness. But whatever the impression may be we shall have a true picture of the country. The country will have been properly described to us and we shall really know it. This, I take it, is the very essence of geography; and if so it is the direction in which we ought to move.

Since our last Anniversary Meeting this Society has suffered grievously in the loss of the great explorer, Sir Ernest Shackleton, and that most cultured traveller and geographer, Lord Bryce. Shackleton was the very embodiment of the spirit of adventure. He was never at peace with himself unless he was penetrating deep into the heart of some utterly unknown region. And though we grieve his loss, we are grateful to him for having so faithfully carried on the glorious traditions of our race. In Lord Bryce we lost one who, with marvellous physical vigour, combined an eager, trained, and cultured intellect, which he used unsparingly year by year during his long life in much that added to the progress of geography.

Of another great geographer the memory has been perpetuated by the erection during the year by the Peruvian Government of a bust of Sir Clements Markham, which was graciously unveiled by H.R.H. Princess Louise (Duchess of Argyll). And we are glad to feel that the fine work accomplished in Arabia by that very promising officer, the late Captain Shakespear, is being more fully and widely known through the publication of the results of his travels in our *Journal*.

It is a matter of particular regret to us that the most useful work which was being done by the Permanent Committee on Geographical Nomenclature may be brought to an untimely conclusion unless financial aid from outside is forthcoming. Lord Edward Gleichen had devoted his energies and his experience indefatigably to this work, and all the Departments of State whom it affected had acknowledged its value, but

in the interests of economy the Treasury were unable to provide the necessary funds for publishing the various lists of names, and though this Society has contributed as much as we can afford we have been obliged to make appeal to every kind of society and institution for aid to carry on a work which will do so much to aid in the proper pronunciation and transliteration of names of places and geographical features in foreign countries and prevent confusion in identifying them.

During the present Session we tried the experiment of holding informal receptions in the evenings at the Society's house. But, except on one or two occasions when something of special interest was on exhibition, they were not well attended, and it will probably be well in future only to hold them for some special purpose.

As this is my last Presidential Address, I take the opportunity to acknowledge my indebtedness to Mr. Hinks. He devotes his abilities and energies whole-heartedly to the affairs of the Society, and conducts them with thoroughness and competency. The preparations for the Mount Everest Expedition added greatly to his labours, but the efficiency with which it was organized was largely due to Mr. Hinks.

In closing my address I would once again thank the Society for the honour which you did me in electing me your President, and I would express the hope that I have carried out my duties to your satisfaction.

THE NATURAL HISTORY OF SOUTH-WESTERN TIBET

A. F. R. Wollaston

Read at the Meeting of the Society, 20 *February* 1922.

TO a naturalist Tibet offers considerable difficulties; it is true that in many places animals are so tame that they will almost eat out of your hand. In the Rongbuk valley the burrhel come to the cells of the hermits for food, and in every village the ravens and rock doves are as tame as the sparrows here in London. But against this tameness must be set the Buddhist religion, which forbids the people from taking life. So, in order to avoid giving possible offence, we had to refrain from shooting in the neighbourhood of monasteries and villages, and that was a very severe drawback, as birds congregated principally about the cultivated lands round villages. In spite of this disadvantage we made considerable collections of mammals and birds, and we brought back a large number of dried plants and seeds, many of which it is hoped will live in the gardens of this country.

Crossing over the Jelep La from Sikkim into Tibet in the latter part of May, we found the country at 12,000 feet and upwards at the height of Spring. The open level spaces were carpeted with a purple primula (*P.*

gammieana) and a little yellow flower (*Lloydia*) and many saxifrages. The steep hillsides were ablaze with the flowers of the large rhododendrons (*R. thomsoni*, *R. falconeri*, and *R. aucklandi*,) and the smaller *Rhododendron campylocarpum*, an almost infinite variety of colours. A descent through woods of pines, oaks, and walnuts brought us to the picturesque village of Rinchinggong, in the Chumbi valley. Here we found house martins resting under the eaves of the houses. From Rinchinggong we followed the Ammo Chu, the river of the Chumbi valley, upwards for four long days to its sources in the Tibetan plain. In its lower course, between 9000 and 12,000 feet, the valley was gay with pink and white spiræas and cotoneasters, red and white roses, yellow berberis, a fragrant white-flowered bog-myrtle, anemones, and white clematis. Dippers, wagtails, and the white-capped redstart were the commonest birds along the river-banks. About 12,000 feet is a level terrace, the plain of Lingmathang, where the stream meanders for 2 or 3 miles through a lovely meadow covered in the spring with a tiny pink primula (*P. minutissima*): it looks a perfect trout stream, but what fish there are are few and small in size. Between 12,000 and 13,000 feet you ascend through mixed woods of pine, larch, birch, and juniper, with an undergrowth of rhododendrons and mountain ash. The larches here have a much less formal habit of growth than those of this country, and in the autumn they turn to a deep golden colour. The berries of the mountain ash, when ripe, are snow-white and very conspicuous. In the woods hereabouts may often be heard and sometimes seen the blood-pheasant, and here also, though we did not see it, lives the Tibetan stag.

At about 13,000 feet at the end of May you find the yellow primula covering the ground more thickly than cowslips in this country; the air is laden with the scent of it, and growing with it is the pretty heath-like flower (*Cassiope*) with snow-white bells. Here and there were one or two of the large blue poppy (*Meconopsis sp.*), and a white anemone with five or six flowers on one stem. Soon the trees get scantier and scantier, pines disappear altogether, and then birches and willows and junipers, until only small rhododendrons are left, covering the hillsides like purple heather. In a few miles the country changes in character completely, and you come out on to the open plain of Phari. Here at 14,000 feet we saw the common cuckoo sitting on a telegraph wire and calling lustily. This is Tibet proper, and henceforward you may travel for many hundreds of miles and hardly see any plant more than a few inches high. In some places a little purple flower (*Incarvillea younghusbandii*) is fairly common; it lies prone on the sand with its leaves buried out of sight, and as we went westward we found the dwarf-blue iris (*I. tenuifolia*). Animals are few and far between. The kiang, the wild ass of Tibet, is occasionally seen in small parties, and now and again a gazelle; the Tibetan gazelle may sometimes be seen, two or three of them, in company with a flock of native sheep, and taking no heed of the shepherd, but when a stranger tries to

approach they are off like a flash. The only mammals that are commonly seen are the small mouse-hares or pikas (*Ochotona*), which live in colonies on the less stony parts of the plain, where their burrows often caused our ponies to stumble; they scurry off to their holes at our approach, but if you wait a few moments you will see heads peeping out at you from all sides. These gentle little creatures have been called whistling hares; they are not hares, nor do they whistle. The Tibetan name for them is Phüsi, pronounced very much like our pet name for the domestic cat. It may be interesting to record that on one of the pikas I found three fleas of two species, both of which are new to science. Larks of two or three species, wheatears, and mountain finches are about the only birds to be seen on these stony wastes. A small spiny lizard (*Phrynocephalus*) is common up to 17,000 feet; it lives in burrows under stones.

Rising out of the plain north of the Himalayas are ranges of limestone hills, 18–19,000 feet high, running roughly east and west. The hills between Phari and Khampa Dzong are the home of the big sheep (*Ovis hodgsoni*) which are occasionally seen in small companies. On the slopes of these hills are partridges (*Perdix hodgsoniæ*), and in the gorges are seen alpine choughs, rock pigeons, and crag martins. Once or twice at night we heard the shriek of the great eagle-owl, but it was never seen. At rare intervals on these plains one meets with small rivers, tributaries of the Arun river and so of the Ganges. Beside them there is usually more grass than elsewhere, and here the wandering Tibetan herdsmen bring their yaks to graze. The wild yak is not found anywhere in this region. It might be supposed that so hairy an animal as a yak would become dirty and unkempt. Actually they are among the cleanest of creatures, and they may often be seen scraping holes in soft banks, where they roll and kick and comb themselves into silky condition. Another animal of the plains is the Tibetan antelope (*Pantholops hodgsoni*), which is found a little to the north of the region we visited, but the only signs of it we saw were the horns used as supporting prongs for the long muzzle-loading guns of the Tibetans. This animal was probably the Unicorn described by the French priest Huc in 1845.

Here and there the rivers overflow their banks and form lakes or meres, which in the summer and autumn are the haunt of innumerable wildfowl; bar-headed geese and redshanks nest here, families of ruddy shelducks (the Brahminy duck of India) and garganey teal are seen swimming on the pools. Overhead fly sand-martins, brown-headed gulls, common terns, and white-tailed eagles. Near one of these lakes one day I watched at close distance a red fox stalking a pair of bar-headed geese, a most interesting sight, and had the satisfaction of saving the birds by firing a shot in the air with my small collecting gun just as the fox was about to pounce on his intended victim.

Tinki Dzong is a veritable bird sanctuary; the Dzong itself is a rambling fort covering a dozen or so of acres, and about its walls nest

hundreds of birds, ravens, magpies, red-billed choughs, sparrows, hoopoes, redstarts, wagtails, and rock doves. In the shallow pool outside the Dzong were swimming bar-headed geese and ruddy shelducks with families of young, all as tame as domestic poultry. The Dzongpen explained to me that it was the particular wish of the Dalai Lama that no birds should be molested here, and for several years two lamas lived at Tinki, whose special business it was to protect the birds.

Crossing over a pass of about 17,000 feet, the slopes gay with a little purple and white daphne (*Stellera*), said by the natives to be poisonous to animals, we came in about two days to a plain of a different character, miles of blown sand heaped here and there into enormous dunes, on which grows a yellow-flowering gorse. In the wet season this plain becomes a huge lake at the junction of the Arun river and the Bhong Chu, and it was from here that we saw our first view of Mount Everest.

Following up the valley of the Bhong Chu we crossed the river by a stone bridge near Shekar Dzong. Here we found a colony of white-rumped swifts nesting high up in cliffs and ruddy shelduck nesting in holes among the loose boulders below. The slopes facing south were covered with a very pretty blue-and-white flowering shrub (*Sophora*); the foliage is a delicate silvery grey, and the plant would be a great ornament to English gardens.

At Tingri we found ourselves in a large plain about 20 miles long by 12 miles wide: a large part of the plain is saturated with soda, and is almost uninhabited by bird or beast. Along the rivers which traverse the plain is very good grazing for large flocks of sheep and goats. The sheep are small and are grown entirely for wool; the flesh, which was our principal food while we were in Tibet, has a pronounced flavour of lanoline. By means of a simple system of irrigation a large area of land near Tingri has been brought into cultivation. The principal crop here is barley, which constitutes the chief food of the people; they also grow a large radish or small turnip, the young leaves of which are excellent food. Iron ploughshares are imported from Nepal, and ploughing is usually done with a couple of oxen. The animals shown in the picture are a cross between the ordinary domestic ox and the yak, called by Tibetans "zoh." They are more powerful than the yak, and are excellent transport animals. We found barley grown in many districts up to 15,000 feet—it does not always ripen—and in the valley of the Dzakar Chu, near its junction with the Arun, is a small area where wheat is grown at an altitude of about 12,800 feet. Peas are grown in the Arun valley near Kharta, where they ripen in September and are pounded into meal for winter food of cattle as well as of the Tibetans themselves. I regret to say that I did not bring back specimens of these interesting and hardy cereals.

In the month of July Major Morshead and I made an excursion over about 150 miles of unknown country to the south-west of Tingri. Across the plain we came first to the village and monastery of Langkor, an

YELLOW PRIMULAS, UPPER TEESTA VALLEY, JUNE

DATURAS AT RONGLI

PLOUGHING WITH ZOH (OX × YAK)

EDELWEISS AT 16,500 FEET

HEADMAN OF KHARTA

important place of pilgrimage among Tibetan Buddhists. There is a pretty legend relating to the place, which ought to be remembered:—

Many generations ago there was born in the Indian village of Pulahari a child named Tamba Sangay. When he grew into a youth he became restless and dissatisfied with his native place, so he went to the Lord Buddha and asked him what he should do. The Lord Buddha told him that he must take a stone and throw it far, and where it fell there he should spend his life. So Tamba Sangay took a rounded stone and threw it far, so that no man saw where it fell. Many weeks and months he sought in vain until he passed over the hills into Tibet, and there he came to a place where, although it was winter, was a large black space bare of snow. The people told him that the cattle walked round and round in that space to keep it clear from snow, and in the middle of it was a rounded stone. So Tamba Sangay knew that the stone was his, and there he made a cell and dwelt until he was taken on wings to heaven. And the place is called Langkor, which means "the cattle go round," to this day. The people for many miles about had heard the stone as it came flying over the hills from India; it made a whistling sound like "Ting," so the country came to be called Tingri, the Hill of the Ting.

Going west over the Thong La, at about 18,000 feet we found for the first time the beautiful little gentian (*G. amœna*). It is not easy to see until you are right over it, when it looks like a little square blue china cup; some of the flowers are as much as an inch in diameter. Here also was just beginning to flower the dwarf blue poppy (*Meconopsis horridula*), one of the most beautiful plants in all that country. It grows in a small compact clump 6 to 8 inches high, with as many as sixteen flowers and buds on one plant. The flowers are nearly 2 inches across and of a heavenly blue. Going down from the Thong La we found, at about 16,000 feet, large colonies of marmots. The Himalayan is larger than the Alpine marmot, and it has a longish tail which it whisks sharply from side to side when it is alarmed: it has a twittering cry, curiously like that of a bird of prey.

Farther on the stream we were following opened out into an almost level valley about a mile wide, bounded on either hand by rounded limestone hills. Here and there were small villages, in the neighbourhood of which were numerous hares: it may not be generally known that the hare is occasionally a very foul feeder. The inhabitants have made very elaborate irrigation works in this valley, and here for the first time we saw crops of mustard, which add welcome splashes of colour to the rather drab landscape and have a delicious scent in the sunshine. The mustard seed is crushed for oil, which is burnt in monastery lamps.

At Nyenyam we found ourselves near to the great mountain Gosainthan (26,291 feet), of which I had had a glimpse from 20 miles' distance, two glorious peaks like mighty Matterhorns; but though we walked many miles up the main valley leading towards it, we saw nothing but fog. On

an island in the torrent of that valley I saw a pair of the curious curlew-like birds, the ibis-bill (*Ibidorhynchus*), evidently with eggs or young, but it was impossible to reach them. The most conspicuous flowers in this valley were a little bushy cistus with golden flowers the size of a half-crown, a white potentilla with red centre, which carpeted the drier hill-sides, and a very remarkable louse-wart (*Pedicularis megalantha*) with two quite distinct forms, one purple, the other yellow.

At Nyenyam the river we had been following from the Thong La plunges into a gorge many thousands of feet deep and cuts through the main chain of the Himalaya to join the Kosi, a tributary of the Ganges, in the lowlands of Nepal. Turning back eastwards in the direction of Mount Everest we crossed several passes of 17,000 or more feet and valleys narrowing into gorges similar to that of Nyenyam. Going up to one of these passes, we found at an altitude of about 15,000 feet the ground for an acre or more covered with an almost pure white primula with a very delicate primrose scent (*Primula buryana*). Near there passing through the holy mountain-side of Lapche Kang we came to the temple of Lapchi, which is well known to all Buddhist India and Tibet, and is visited by thousands of pilgrims yearly. This was formerly the abode of Mila Respa, a Tibetan incarnation of Buddha. He lived in this mountain valley, and the faithful may still see his footprints in certain caves. He seems to have been an unusual kind of saint, who liked to have his little joke. The following story, which was told by the lama in charge of the temple at Lapche, has a certain interest for naturalists, and may be related here :—

He was walking with a disciple on the mountain one day, when they found an old yak's horn lying in the path. Mila Respa told the disciple to pick it up and take it with him. The disciple refused, saying that it was useless, and passed on not noticing that the saint himself had picked up the horn and put it under his cloak. Soon afterwards a mighty storm descended on them—whether or not it was caused by the saint is not known. He took the horn from under his cloak and crept inside it. "Now," said he, when he was safely sheltered from the rain, "you see that nothing in the world is useless."

Growing about the rocks in this neighbourhood is a very pretty pink-flowered polygonum (*P. vacciniifolium*), which rambles somewhat after the manner of a cotoneaster. A bird which I did not see elsewhere in Tibet was the wall-creeper, which was constantly seen climbing about the temple and the big boulders of Lapche.

Going south and east from Lapche we crossed more high passes, and near the top of one of them we found one of the most beautiful blue primulas in the world. Each flower has from three to six bells about the size of a thimble, lined inside with a kind of frosted silver (*P. wollastonii*). It was not long after finding this blue primula that we saw for the first time in nearly three weeks one of the great snow mountains that surrounded

us. During most of that time we had seen little but clouds and fog. Apart from the remarkable beauty of its form this peak has a peculiar interest of its own. Our friends the late enemy always insisted on labelling Mount Everest Gaurisankar, but this mountain 36 miles west of Everest is the true and only Gaurisankar (*Journal*, Feb. 1922, No. 22). At the foot of this mountain flows the Rongshahr river, at this point about 10,000 feet above sea-level. We followed up the Rongshahr valley, notable at that season of the year for its excellent wild gooseberries and its red roses, to the Phüsi La, and thence we followed the tracks of Colonel Howard-Bury and other members of the expedition to Kharta in the Arun valley, about 20 miles east of Mount Everest.

Kharta is curiously situated as regards climate—the wide dry open valley of the Arun narrows abruptly and the river passes into a deep narrow gorge, where it falls rapidly at the rate of about 200 feet to the mile. The monsoon clouds roll up the gorge to its mouth, where they are cut off sharply, so that within a mile you pass from the dry climate of Tibet to the moist steamy air of a Nepalese character with its luxuriant vegetation. The Kharta valley joins the Arun here from the west, and is practically on the border between these two climates, getting many hours of sunshine in the day and very frequent falls of rain, with the result that the crops of barley grown are as fine as can be seen anywhere. There is a considerable population, of a more enlightened kind than we had met hitherto; some of them even grow flowers for pleasure. The gentleman shown in the plate, our particular guardian at Kharta, was not only an accomplished musician and dancer, but he was also a keen horticulturist; he had a pretty garden of his own, and one day he presented Colonel Howard-Bury with a pot in which were growing marigolds, kosmos, a mallow, and some barley.

About the larger houses in this region are usually planted poplars and junipers, and it was about 10 miles from Kharta that we saw a big poplar nearly 40 feet in girth; we were told that it was 500 years old.

From Kharta we made excursions to the Kama valley, a journey of about two days to the south-west. After climbing to a low pass of 15,000 feet we came to a valley filled with a dozen or so of small lakes or tarns of wonderful colours. They appeared to be inhabited only by tadpoles; no signs of fish were seen. Here were growing large beds of purple and yellow iris (allied to *I. sibirica*); the steeper banks were blue with a very striking campanula (*Cyananthus pedunculata*), growing out from the dwarf rhododendrons in dry places were tall spikes of a claret-coloured meconopsis, now going to seed—some spikes had as many as twenty seed-pods—and growing in the moist places beside the lakes and streams was the tall yellow primula (*P. elongata*), growing to a height of 30 inches. Over another pass, the Chog La (17,000 feet), we began to go down into the Kama valley. At about 14,000 feet we picked a quantity of wild rhubarb, a far better vegetable than the tame variety; and a little lower

down we came to large blue scabious, 3 to 4 feet high, a big dark blue monkshood, and quantities of the tall yellow poppy. Rhododendrons, birches, and junipers begin at about 13,500 feet, and at 12,000 feet the junipers are the predominating tree; they are of immense size, upwards of 20 feet in girth and 120 to 150 feet high, and of a very even and perfect growth. Here we met with the Sikkim black titmouse (*Parus beavani*), and a little lower down amongst the silver firs (*Abies webbiana*) we came upon bullfinches (*Pyrrhula erythrocephala*). At 11,000 feet I saw a langur monkey (*Semnopithecus entellus*), the only monkey we saw in Tibet. In the open spaces among the trees grew many parnassias, a tall green fritillaria, and a very sweet-scented pink orchis. We went down through bamboos, rhododendrons, and magnolias to the almost tropical heat of Lungdö, about 8000 feet, near the junction of the Kama with the Arun river, where the blue pine grows. After an excursion to the Popti La, one of the principal passes from Tibet to Nepal, where we were astonished to find at 12,000 feet an abundance of very active leeches, we returned to Kharta.

Early in September we started up the Kharta valley on our way towards Mount Everest; by that time the harvest of peas and barley was already begun. At this season the rhododendrons and many other plants were beginning to seed, but some of the gentians were at their best, particularly *Gentiana ornata*, which carpeted the ground with a variety of blues. Near our camp at 17,000 feet, along the edges of streams, a very handsome dark blue gentian (*G. nubigena*) with half a dozen flowers growing on a single stem was very conspicuous, and growing with it was an aromatic little dwarf purple and yellow aster (*A. heterochæta*). In the stony places grew up to 19,000 feet the dwarf blue poppy (*M. horridula*) mentioned above, and many saxifrages, notably a tiny little white one (*S. umbellulata*). On the steeper rocks from 16,000 feet to the snow-line (roughly 20,000 feet) were found edelweiss (*Leontopodium*) of three species. Very noticeable at these altitudes are the curious saussureas, large composites packed tight with cotton-wool: if you open one of them on the coldest day, even when covered with snow, you find it quite warm inside, and often a bumble-bee will come buzzing out.

Another very interesting plant at 17–18,000 feet is a dwarf blue hairy delphinium (*D. brunonianum*) with a strong smell. The Tibetans dry the flowers of this plant and use them as a preventive against lice, without conspicuous success. When a Tibetan dies, his body is undertaken by the professional butcher, who cuts it up and exposes it on the hills to be disposed of by the vultures and wolves. A body tainted with the delphinium flowers is unpalatable to the scavenger, and it is well known that a man must have been wicked in life whose body is rejected by the vultures and wolves. The highest plant we found was a little Arenaria which grows among the loose stones to 20,000 feet and above.

Animal life above 17,000 feet is scanty. Our camps at 17,000 and

LEPCHA COLLECTOR HOLDING *SAUSSUREA*

LOWER VALLEY OF THE KAMA CHU

500 YEAR OLD POPLAR AT LUMEH

LOOKING BACK TO DOCHEN

20,000 feet were visited daily by ravens, black-eared kites, red-billed and alpine choughs, and lammergeiers. The large Tibetan snow-cocks were very conspicuous and noisy on the slopes between 17,000 and 20,000 feet. Pikas (*Ochotona*) of a new species was found from 15,000 feet to the snow-line, and small voles were common at 17,000 feet. At about the same altitude a small black rat lived among the great boulders of the moraines, but we never succeeded in catching one, and in the same place lived a very dark brown wren of a new species of which only one young bird was brought home. Mice of some kind came into our tents at 20,000 feet and ate our food, but escaped without being seen. Burrhel were often seen at 18–19,000 feet and their tracks at 20,000 feet. Wolf, fox, and hare were all seen above 18,000 feet, and undoubted tracks of both fox and hare were seen on the Kharta glacier at 21,000 feet, at which height also I saw a hoopoe flying across the glacier, and a small hawk, which appeared to be almost white underneath, flying swiftly overhead.

A few hundred feet higher, about 21,500 feet, we came across those tracks which afforded such fun to so many people. It is not necessary to assure a scientific society that there are no such creatures as "abominable snow men," that apes are not alpine climbers, and that Himalayan bears do not make excursions to 10,000 feet above the last fruit-bearing tree. There can be no doubt, I think, that the tracks we saw were those of a wolf loping along at a good gait; the snow was soft, and the tracks had got partially merged together. Curiously enough, I have in my own experience come across similar stories of wild men in high mountains in such widely separated regions as Ruwenzori in Central Africa and in Dutch New Guinea, and I believe them all to be equally devoid of foundation.

The photograph (*Journal*, Feb. 1922, No. 21) taken from our camp on Lhakpa La (22,350 feet) is interesting not only because it shows the north col and the beginning of the slope by which the attempt on Mount Everest is to be made, but also because when I was taking this photograph I saw come sailing over this peak to the right, that is the north peak of Everest, 24,730 feet high, and apparently high up above the peak, a lammergeier or bearded vulture, a bird which soars and sails and never flaps its wings except at the moment of getting off the ground. The means by which so large a bird moves without effort in so rare an atmosphere, about one-third of the normal, is worthy of the attention of aviators.

The photograph of the summit of Mount Everest (*l.c.* No. 12) has another significance for diligent inquirers. For some weeks before we came within reach of the great mountain we heard from the natives rumours of the Snow Frog. This mysterious reptile is said to live only at the tops of the highest mountains, and its blood is an unfailing remedy for all diseases of the body and of the soul.

Much has been written and talked about the wonderful colours of

Tibet; it is impossible to exaggerate them, and it is much to be hoped that this year's expedition will bring us back something more than photographs. But nothing has been said about that country's smells. I am not thinking so much of the rank savour of a Tibetan village, nor of the peculiar bouquet of the Tibetan person, nor of the acrid taste of the smoke of yak-dung which flavoured all our food for five months. I am thinking rather of valleys laden with the smell of roses, of meadows carpeted with sweet-scented primulas, and of the delicious fragrance of rhododendron leaves trodden underfoot on a frosty morning in September. These are things which we shall remember long after the petty worries of Tibetan travel are forgotten.

In conclusion, I must thank the authorities of the Natural History Museum and of Kew Gardens for the care with which they have worked out our collections.

Before the paper the PRESIDENT said: It was a very great disappointment to us that at our Mount Everest Meeting at the Queen's Hall at the end of December, time did not permit of Mr. Wollaston giving us an account of the natural history of the Mount Everest region. That disappointment is made up for by our having him here this evening, when we can hear his account at far greater length and shall have the advantage of being able to discuss it in a way we should not have been able to do at the Queen's Hall. I have great pleasure in introducing to you Mr. Wollaston, the distinguished naturalist of the Mount Everest Expedition.

Mr. Wollaston then read the paper printed above, and a discussion followed.

Sir DAVID PRAIN (Director, Royal Botanic Gardens, Kew): I will not at this hour detain the audience long, but I would like to take this opportunity of saying to the President of the Society, to the members, and to those who have been responsible for organizing the Expedition, how great a pleasure it was to me to have an opportunity of assisting in working out the small collection of plants that Mr. Wollaston and his friends were able to make. A predecessor of mine in Calcutta, Dr. Wallich, as long ago as 1821 was asked to visit Nepal when Sir Robert Colquhoun of Luss was the Resident there and was able then to arrange to secure collections of plants from Gosainthan. Another predecessor of mine in Calcutta, Sir George King, from 1871 onwards made it his business to endeavour to have a complete survey made of the vegetation of the valley of Chumbi and the plain of Phari to the north of it. Knowing as we did practically the whole of the plants from Chumbi and Phari to the east, and having very considerable collections from Gosainthan to the west, it was not to be expected that many new plants would be brought home by the Mount Everest Expedition. A certain number there are; six or seven, perhaps, and you could not help finding a few when so large an area was so carefully examined by the members of the party. But the great interest of the collection is that it fills up a gap between two areas that have been fairly well known; one for about a hundred years and the other for about fifty years. The lousewort that Mr. Wollaston has mentioned is a very handsome plant in both its forms, one with pink blossoms, the other with yellow. It is very interesting

to me, because I happened to make a special study of those plants a number of years ago—I do not like to say how many now—and I found then that the yellow one is a very characteristic plant of the North-West Himalaya, whereas the pink form is an equally characteristic plant of the Eastern Himalaya. Except as regards the colour of the flower, it is really hardly possible to distinguish one from the other, and it is extremely interesting to find that Mr. Wollaston had the privilege of being just in that part of the Himalaya where the areas of these two plants meet and to see them slightly overlap. In conclusion, may I repeat the pleasure it has given me to see those plants, and to say how indebted we all are to the Mount Everest Committee for having enabled the members of the Expedition to make a collection of plants for us?

Sir SIDNEY F. HARMER (Director, Natural History Museum): It is a special pleasure to obey your commands, Mr. President, and make one or two remarks with regard to Mr. Wollaston's address this evening, because he is an extremely old friend of mine whose acquaintance goes back to the time when he first entered as an undergraduate at a Cambridge College. Since then I have been further indebted to him by being able to read some of his charming books in which he has described the results of his travels abroad, books in which his word-pictures have been so vivid that they are capable of transporting one to the localities described and helping one to enjoy the pleasures of travel which one will probably never be able to experience in one's own person. In the course of his remarks this evening Mr. Wollaston gave us a very interesting story showing that even the discarded horn of a yak is not without its utility. I think it was somewhat earlier in his remarks that he mentioned the fact that he had discovered two species of fleas, and I noticed at the time that there was a little disposition to think that a subject for mirth. If the earlier story had preceded the mention of the fleas, you would perhaps have taken a somewhat different view of it, because if there is one thing that is certain it is that the systematic study of fleas is one of the really important things in this world. I do not mean that to be a humorous statement. I believe it to be strictly and literally true. In large areas of the world the plague is transmitted by the agency of fleas, and a knowledge of the species and the life-history of those insects is of the very greatest importance. By a curious coincidence Mr. Wollaston also mentioned the subject of marmots, and here again the marmot is an animal which has been accused of being largely instrumental in transmitting one of the most dreaded diseases that occur in the Asiatic continent, the disease known as pneumonic plague. We may safely assert that even in cases where the study of a particular animal would appear to have very little significance, it may, on the contrary, be of the greatest importance. But quite apart from the possible economic aspects of the question, we are extremely interested in knowing what there is to be found in the region of Mount Everest, and in any unexplored part of the world. I have great pleasure in welcoming any co-operation between this Society and the Natural History Museum in further investigating questions of this kind. The fauna of Mount Everest was of interest to us largely because it is a part of the world which has been quite unknown zoologically, and from which we had no collection. A theory has recently been propounded to the effect that the mountain summits are places where life probably originated on this globe, the idea being that when the world was cooling down the mountain summits were the first places which came to acquire a temperature sufficiently low to allow life to come into existence. I may say at once we did not expect to find

any trace of this ancient history, even if that theory should be correct, which is by no means certain. The mountains are probably far too recent for that. But Mount Everest was a district of which we knew very little, and we are extremely glad to have had this opportunity of learning more. We could hardly expect that, standing as it does on the line between the great Palæarctic area to the north and the Oriental region to the south, we should find anything of extraordinary novelty. In this respect our experience corresponds with that of Sir David Prain. No conspicuously new types of animals were discovered, but we did not expect it. The collection consisted largely of birds, among which we found not only representatives of species commonly seen in our own country, but also representatives of other birds not quite the same, but differing specifically from those we have here. One of the interesting results was in connection with certain birds which were found nesting high up on Mount Everest. It is well known that some of these birds, waders in particular, are in the habit of seeking high latitudes, such as the Arctic Circle, for instance, in which to nest. Why they do it is perhaps not quite obvious. But it is interesting to find that here we have a case in which a bird, instead of going a long journey towards the far north, is able to reach a high altitude and thus get the sort of Arctic conditions in which it rejoices in order to undergo its nesting period. Then in addition to birds there is an interesting little collection of mammals, including a new form of the animals which Mr. Wollaston has referred to as whistling hares. We are rather disappointed that he did not bring home any of the rats and mice which he has told us invaded their tents at certain times, but we hope that the next Expedition will be more successful in this respect and that the animals in question may prove interesting. In addition to this the collection included a few insects, there being some butterflies and moths and one or two batrachians, and among the latter a very interesting new form. The collection is one which we are extremely glad to have, and we are greatly indebted to the Expedition and to Mr. Wollaston for having made this addition to our national collection.

Mr. N. B. KINNEAR: Mr. Wollaston is to be congratulated on the collection which he has brought back. We have heard of the number of things he had to do: besides collecting animals, he had to collect plants and at the same time look after the health of members of the Expedition. The first thing that strikes one on looking at the collection of birds is the extraordinary worn state of plumage which most of the specimens are in. This I think is due, to a great extent, to the high elevation at which the birds were taken, and probably, in the more exposed parts, to the winds to which they were subjected. In a general survey of the collection one finds, of course, that the birds come from a great variety of localities, so it is rather difficult to generalize, but about a half are resident or semi-resident in the Himalayas, that is, birds which move up and down the Himalayas according to the seasons. Of these we might mention the four different kinds of Accentors, birds like hedge-sparrows; the different kinds of finches, Rose Finches, Snow Finches and the Ground Finches; Cinnamon and Tree-sparrows; Snow-pigeon and Snow-partridge. About a quarter of the birds are made up of summer visitors, which simply go to these high altitudes for the purpose of nesting, and during the cold weather are found in the plains of India. These include the Indian Stonechat, Desert Wheatear, Hodgson's Rose-finch and the Short-toed Lark, Redstarts, Wagtails, several Pipits, a Redshank and the Tibetan tern. A few birds are confined entirely to the northern side of the Himalayan Range; we do not get them on

the southern slope at all. They are the Brown Ground Chough, a small bird about the size of a thrush with a bill like a chough, which runs about the ground and goes in small flocks; Prince Henry's Babbler, Walton's Turte, and perhaps the Tibetan Sky-lark, described some years ago from the south-east of Tibet, its breeding ground being at the head of the Chumbi Valley. Where this last bird goes in winter is not yet known. There are in the collection only two birds which were true migrants, birds which were simply passing through. One is Temminck's Stint and the other a wagtail. Perhaps the most curious bird of the whole collection was the Pied-crested Cuckoo. This is a very common bird in the plains of India, and as a rule it is never found above 5000 feet, but extends from Kashmir right down to Cape Comorin and is a local migrant. In the beginning of the monsoon a certain number of them come to Bombay, and for some reason or other they are always pursued and harried by the common House Crows. Why they do it, I do not know, because this cuckoo does not lay in the House Crow's nest, but in the nest of babblers. One can only suppose that this cuckoo in the foothills of the Himalayas was mobbed by House Crows and started wandering up, gradually lost itself, and eventually turned up at, I think, about 14,000 feet. Temminck's Stint, about the size of a sparrow, which nests on the borders of the Arctic Ocean, was very interesting, especially because I think Mr. Wollaston told me the place at which it was found was about 17,000 feet, and to get there it had to fly over a range of 22,000 feet. This shows that high mountain ranges are no barrier to some birds, at least on migration. This is very interesting to learn. Of course we knew a certain amount about the heights over which birds will migrate from the observations made by the different naturalists on the first and second Yarkand Expedition. As Sir Sidney Harmer said, a certain number of the birds are very similar to those found in this country. I might mention the Himalayan Blackbird, which is practically the same as our blackbird, only it is larger; the Tree Sparrow, the Redshank, and Hodgson's Rose-finch which is very similar to the Common Rose-finch; the Hoopoe, Temminck's Stint, and the Dusky Redshank are all the same as you get in this country; and the Indian stonechat, which is very like our stonechat but slightly different, has been found in Norfolk on migration. The Himalayan Alpine Accentor, which was one of the birds seen highest up, is very like the Alpine Accentor found in the Swiss Alps, and one of the snow-finches, Adams' Snow-finch, discovered a great many years ago in Ladak, is practically the same as the snow-finch of the Alps. I do not think there is anything more to say about the birds. They are an interesting collection.

Mr. W. R. DYKES (Secretary, Royal Horticultural Society): I did not at all expect to be called upon to make any remarks on the seeds found during this interesting Expedition. If I may say so, what we have realized so far is that a great number of these plants may be difficult to grow in this country. The various kinds of Meconopsis especially are very difficult, and so are the high Alpine primulas. This year we should be very glad to get seeds of the cereals and of the common plants. Mr. Wollaston told us of the wild gooseberries which they ate going up one of the valleys, but we have not yet got seeds of that gooseberry, although we should be glad to have them. Then I believe a raspberry was found high up of which we should also like to have seeds, and we hope that the results of the Expedition of last year will show those who go out this year that even the commoner plants might be brought back and prove of more permanent value in this country than some of the seeds we have already received, such as the various species of meconopsis and

primula. The irises mentioned interested me especially ; all that I have seen of the seeds that have been brought back are of the Sibirica section. There are, we know, several irises closely related to the *Iris sibirica* in the Chumbi Valley and higher up. But I think the yellow and purple iris which Mr. Wollaston mentioned as growing high up is probably unknown to us, and I think not *nepalensis* but some other species. I have not yet seen that specimen, and I did not know it had been identified as *nepalensis*.

Mr. FRESHFIELD : I feel somewhat abashed at following in the train of so many distinguished representatives of the Natural Sciences. To what has gone before I can, I fear, only contribute a single observation as to the high flight of migratory birds. On the Bezingi Glacier on the north side of the Caucasus, at the point where the watershed attains its maximum height, 15,000 to 17,000 feet, Signor V. Sella found the ice strewn with the skeletons of ducks, larks, and quails, besides others that were unrecognizable. The poor things had evidently been caught in a blizzard. But why, when they had an easy flight open to them along the coast of the Black Sea, did they choose to face the great ice-wall that towers over Suanetia ?

I turn to some more general remarks, which the fact that this is the last meeting at which we shall have any of the members of the 1922 Mount Everest Expedition with us before they start, may render not inopportune.

The other day my friend Captain Farrar, who has been so active in looking to the equipment of the party, accused me of being a pluralist on the ground that I was the only man who had served both as President of our Society and of the Alpine Club. I should not have run the risk of losing any reputation I may have for modesty by repeating Captain Farrar's remark to-night had I not recognized that it indicated and summarized a development of which the Mount Everest Expedition is the most notable expression. I refer to the union of our Society and the Alpine Club for a common object. Since the time, now over forty years ago, when I first became one of your Honorary Secretaries, the establishment of mountaineering in its proper place in the field of geographical discovery and research has been one of the principal objects of my life. There was a date, still within living memories, when in Savile Row we were so engrossed in African swamps and Arctic icebergs that we had little or no time for mountains. Here is one notable instance: so distinguished a traveller as Sir Joseph Hooker had to wait a quarter of a century after the publication of his classic ' Himalayan Travels ' before he received our Gold Medal. Those days are happily long past, and we may look forward with confidence to further co-operation between the Society and the Alpine Club in the exploration of the vast mountain region that spreads across Asia from China to Afghanistan.

Next I desire to congratulate the members of this year's expedition on having been successful where the Survey of India had after fifty years of intermittent endeavour succeeded only in failing. They have ascertained, and that through an official source, the local name for the highest mountain in the world. The Tibetan passport for the 1921 party was made out for the exploration of Chomolungma ; this, we are told, means being translated " The Mother Mountain of the Country." I am not going to revive to-night the old controversy as to the propriety of imposing upon the peak an English name. This, I fear, must now be allowed to be a matter settled for better or for worse. But I do desire to insist that the mountain's authentic local name shall henceforth be inserted on our maps (in brackets if you like) alongside of its English pseudonym. I urge this not only as a matter of courtesy to our Tibetan hosts, but also as one of proper regard to our own rules of nomenclature. We have laid down

that the ultimate authority as to geographical names is the Government of the country in which the objects are situated. The Monarch of Mountains rises not in British territory but in Tibet, and it is only by making a special exception to our rule that we can call it by any but its Tibetan name. May I in the same connection express my hearty sympathy with the action of our climbers in submitting Tibetan names—names that will be intelligible to the people of the district—for the minor peaks that they found to be nameless? This is what Prof. Garwood and I attempted to do twenty years ago in the neighbourhood of Kangchenjunga.

I have been led to mention Kangchenjunga. Allow me a brief digression. It is obvious that the Mount Everest Expeditions are likely to give a fresh impulse to Himalayan climbing and exploration. It may therefore be opportune to remind ourselves that there exists, a week's journey from Darjeeling, a mountain mass only 1000 feet lower than Mount Everest and accessible without frontier difficulties or political hindrances. I would invite the Indian Government to take steps to make it even more accessible. I recognize that the moment is unfavourable. The Government is hard up; we are all hard up. But the request I make is extraordinarily modest. Paths good enough for mules or laden coolies on both sides of the Guicha La, and for the few miles through the forest from Lachen to the foot of the Zemu glacier, a couple of stone huts, such as we have in the Alps, one at Alukthang, one on the Green Lake plain at the head of the Zemu; these facilities would enable mountaineers to penetrate the gaps and climb the minor peaks round Kangchenjunga and to explore further the approaches to that magnificent and most formidable mountain. They would further afford a party of surveyors a delightful opportunity to ascertain whatever errors Prof. Garwood and I may have fallen into in the map we produced, under difficulties, twenty years ago.

I return for a few last words to Mount Everest, but, since I have mentioned maps, may I here express a hope that a revised version of the general map of the mountains between Makalu and Gaurisankar, given with the February number of the *Journal*, may before long be produced by the Survey? In such a region a map that leaves out any indication of the main watershed is like the play without Hamlet, or rather like a play without any plot at all. The detailed map of the approach to Mount Everest, on the other hand, is highly commendable as an adequate and apparently correct representation of physical features and of the relation of the glaciers to the mountain structure. It is an interesting example of the use photographs may be in cartography.

Finally, the question before all our minds to-night is, "Can Mount Everest be climbed this year?" We have been told on the best authority that the chances are fifty to one against success. I am not in a position to dispute that statement. It is obvious that success must depend on a rare and happy combination of circumstances. First, the mountain must be in the best condition and the weather set fair; next, you must have the *right* climbers. By right I do not refer to climbing capacity, as to that we are assured we have the best men, but to individuals exceptionally immune from the effects of the rarity of the air. In this respect climbers vary greatly. At a height of over 20,000 feet I have seen some of my party run about in the snow as if they were on a beach at sea-level, while others were suffering from divers degrees of lassitude. For myself I felt nothing until I walked uphill, but then I lost breath relatively quickly; that was at the age of fifty-five. It is difficult to ascertain beforehand each individual's sensitiveness, and even in the same man his powers may vary on different days.

I would conclude with certain grounds for hopefulness brought to light by last year's reconnaissance. The final climb appears to offer no very serious obstacles except that of altitude. The next 4000 feet above the North Col are not too steep. Before the monsoon much of this slope may prove rock, and at any rate there are crags that promise sites for a bivouac at 26,000–27,000 feet. Easy rock is far less tiring than snowslopes. The final ridge above the shoulder looks roomy, though the last 200 feet may be steep. Exhaustion ensues far less quickly on airy ridges than in hot and soft snow basins. Nor need we infer from last year's experience that high winds prevail perpetually on the summits. During the two months I was in Sikkim in the autumn of 1899 I never met a gale or saw the snow flying from the ridges. We are not yet in a position to generalize.

Nil desperandum is a good motto for mountaineers. Hope for success, and imbue as far as possible your companions and followers with the same feeling. By so doing you will diminish the odds against you by one-half—they will still be heavy enough.

The PRESIDENT: Mr. Wollaston began his address by telling us how well the party were during last season. The Chinese go on the principle of paying their doctors as long as they are well and not paying them when they are ill. On that principle, I think we must congratulate Mr. Wollaston. Mr. Wollaston said that it was a misfortune that in certain places they were not allowed to shoot. This year the Tibetan Government have made a representation to us that the Expedition should not shoot in Tibet. That has the great disadvantage that the Expedition this year will not be able to bring back the same amount of natural history collections that the Expedition last year brought back. But, on the other hand, I hope they will have very special opportunities of observing wild life, which in Tibet is so much tamer than elsewhere. We have fortunately this year been able to send a special photographer, who will have nothing else to do but to photograph, and I am sure Captain Noel will take the hints that have been given this evening and bring us back photographs and cinematographs of the wild life of that country. So that it may not be altogether an unmixed blessing that there is to be no shooting. The time is late, but I know perfectly well that you will wish me to thank Mr. Wollaston for his exceedingly interesting address. It has been most fascinating to listen to him, and I think we are all rewarded by this opportunity that has been given us to make up for what we lost at the Queen's Hall.

THE TIGRIS ABOVE BAGHDAD

Lieut.-Commander A. S. Elwell-Sutton, R.N., B.A.

Read at the Meeting of the Society, 3 April 1922.

THIS is an account of the work done by one of H.M. gunboats on the river Tigris above Baghdad in 1918. From a geographical point of view the importance of it lies, perhaps, in the survey of the river between Samarra and Tikrit, which was carried out at the request of the G.O.C. 1st India Army Corps with a view to its navigability; but some account of our experiences generally may be of interest.

So far as has been ascertained there have been only three attempts to

navigate the Tigris beyond the mouth of the 'Adhaim, and none in any vessel approaching the size of a river gunboat. In 1835 a boat belonging to Colonel Chesney's party got as far as Sultan Abdallah, some 35 miles below Mosul. In April 1846 Lieut. R. G. Jones got just beyond El Fatha, about 35 miles above Tikrit. And at some later period the *Comet*, a small vessel that plied as a rule between Baghdad and Basra, is said to have actually got to Mosul; but, strange to say, there appears to be no record of this voyage at the Royal Geographical Society, and in no case was any attempt made to chart the river. Charting the river below the 'Adhaim would be useless, as the bed, being soft, is continually changing; whilst above that point it seems to have been generally accepted that the river is unnavigable. On the other hand, as will be explained more fully later on, the bed is much more permanent in the upper reaches, and consequently charts have some permanent value.

It fell to the lot of our gunboat to get up the river to Tikrit, some 150 miles above Baghdad, and her crew charted the river with some accuracy between Samarra and Tikrit. The gunboat in question was one of the so-called "Fly" class, and our particular species was the *Caddisfly*. These vessels were of 100 tons burthen, with a length of 120 feet, a breadth of 20 feet, and carried a long-range 4-inch gun, a 12-pdr., a pom-pom, and 5 Maxims, on an average draft of a little over 3 feet. The living quarters and navigating positions, protected by bullet-proof screens, were built up from the upper deck, and housed a crew of some thirty officers and men, including a variegated collection of supernumeraries, amongst them an Arab pilot, a Somali boy who acted as interpreter, and a young Armenian refugee who acted as "boy."

The fall of Baghdad had seemed to foreshadow the end of naval activity of any importance for the rest of the campaign, and as a matter of fact the gunboat flotilla during the latter part of 1917 had done little but patrol up and down the Tigris, with occasional intervention in the quarrels of Arab tribes. We came in for one rather exciting incident up the Euphrates, which I have not time to dwell on here. Things on the whole were naturally enough not too cheerful throughout the intense heat of the summer, and their aspect was rendered still more depressing by the poor prospect of any more real activity for us in the future. For the front was far away up at Samarra, and the Tigris was supposed to be quite unnavigable to those parts for vessels of our size. There were, so the reports ran, hard shingly bars with only 18 inches of water on them at the best of times, and swift shallow rapids, and even hidden rocks—all things quite unknown to us hitherto. In the last 600 miles or so of its course, where the river flows through the flat alluvial Mesopotamian plains, there is scarcely such a thing as a pebble to be seen, much less rocks. Grounding was an everyday occurrence below Baghdad and for some 60 miles above, and, so long as you were going upstream, was a light-hearted enough affair. You felt yourself gently stopping, heard a muttered ex-

clamation from your Arab pilot, and then reversed your engines, backed out, and tried another way. It was a bit worse going down, because the current tended to swing you round broadside-on to the shoal after the bows touched, and it meant laying out the kedge with only a small iron dinghy to carry it upstream. Still it was nothing serious; it only meant delay, and a friendly passing vessel could lend a hand. Rocks were a more serious proposition, more than 600 miles from a slip or dock.

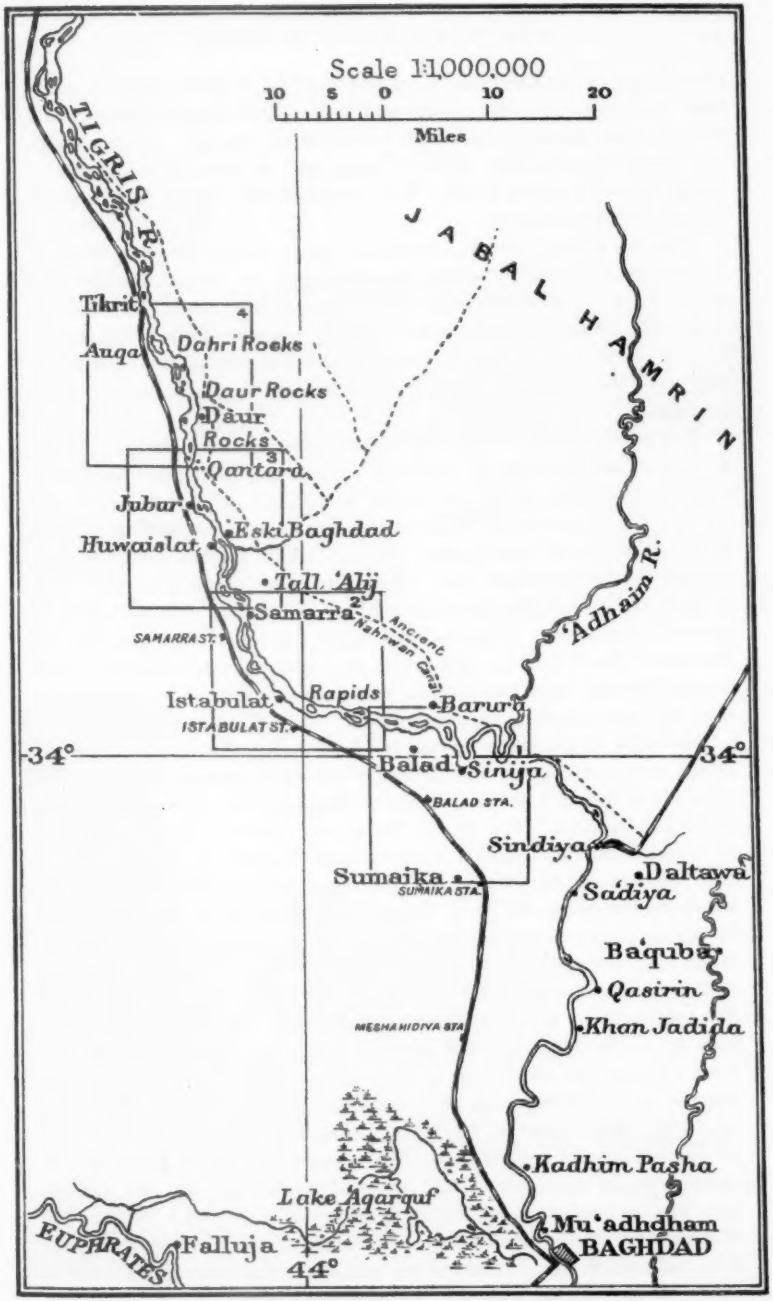
Then again, it so happens that the cool weather period, which begins about October, and which is of course most favourable to military operations, is also that when the river is at its lowest. We had had plenty of opportunity of appreciating the fact coming down from Sindiya to Baghdad in September. In most places there was little more than 3 feet of water—our nominal draft—when there wasn't less. We used to send a portion of the crew, clothed in sun-helmets, on ahead on foot. You could tell by the amount of their anatomy showing above water where the deepest channel lay, and directed your course accordingly.

Now the river doesn't make its substantial rise till March, when the snow begins to melt on the Armenian mountains; and by May, even as far north as Samarra, it is really too hot for satisfactory military operations.

On the other hand there are often plentiful rains in Mesopotamia and on the Armenian mountains in November, December, and January, and these cause temporary rises of the river, during which it might be practicable to negotiate the shoals and bars. If an adventurous gunboat could succeed in doing this she might take her place in the first line to meet the expected Turkish offensive, and her long-range 4-inch gun would be a valuable acquisition to the defenders. The objection was that the same flood which might make the bars passable would probably render the rapids quite impracticable.

However, when the *Caddisfly* arrived at Baghdad just before Christmas Day 1917, we had a consultation with the Senior Naval Officer. As a result we were instructed that after relieving the advanced gunboat at Akab, opposite the mouth of the 'Adhaim, and the most northerly point to which the river had hitherto been navigated by our craft, we were to explore the river as far north as practicable, and ascertain whether, after crossing the bars, the rapids could be negotiated by haulage, the military being asked to supply the requisite man-power.

Accordingly on 7 January 1918 we left Baghdad, but the conditions under which our departure took place occasioned some doubts and qualms. There had been heavy rains during the previous days—the streets of Baghdad bore witness to the fact. It was usual for diners-out to wade through the mud in sea-boots, carrying a pair of shoes in the hand, and the sea-boots were often only just high enough. There must have been heavier rains still up in those Armenian mountains, we thought, for during the night before our departure the river rose no less than the astonishing amount of 2 feet. As a matter of fact, it was obvious that



Sketch-map of the Tigris above Baghdad.

something more unusual than mere rains had taken place, only we didn't hear what it was till later. What we did find, however, was that we could scarcely make headway against the tremendous current. On an average our hourly progress was about 2 miles, and at some of the bends we hardly seemed to move at all. The prospects with regard to the rapids did not look very hopeful.

The rain ceased towards sunset, and as we were a long way short of our proposed stopping-place we decided to push on through the first part of the night. One avoids night-work on the river as a rule, both because of the difficulties of navigation and in order to rest the crew. The searchlight has to be used to light up the banks and any leading marks or buoys that may exist, and with its aid we found our way on this occasion without mishap.

One curious spectacle we remarked that evening. All along the banks as the darkness drew on, we observed what looked like lighted torches or small lamps moving in and out among the brushwood. It was most uncanny. The actors in the affair, when we came to identify them, proved to be nothing more than jackals, and the lighted torches were their eyes glowing in the searchlight rays. We must have hit on a regular pack of them, for though they were plentiful enough we had only seen them in twos or threes before. They had had rather a thin time since the Sanitary Sections of the B.E.F. had got under way, and indeed, cowardly brutes though they are, there had been cases of their entering camps in search of food and even attacking sleeping soldiers.

Next day we got on to Tuwair, and here we heard what had happened on the river. At Tuwair was the first of the three pontoon bridges which at one time spanned the Tigris above Baghdad, the other two being at Ukub and Samarra. The Tuwair bridge was connected by a branch line to Sumaika on the Baghdad Railway, and supplied the line which ran from Sindiya on the left bank right down to Ba'quba on the Diyala. We found the bridge officer in considerable perturbation, not diminished by our inopportune request to have the bridge opened in order that we might pass through. He explained to us in highly figurative language that two nights before a great flood, 20 feet high, had suddenly swept down the hitherto dry bed of the 'Adhaim—one supposes some natural dam up in the Jabal Hamrin, through which the 'Adhaim passes, had burst—that it had carried away the trestle bridge which supplied the brigade on the northern side of it, had wrecked the pontoon bridge which ran from Ukub across the Tigris just below the 'Adhaim's mouth so that the brigade in question was quite isolated, that the derelict pontoons had come down in the morning and smashed his bridge, and that he had only just succeeded in getting it together again in order to pass the supplies over to the unfortunate posts along the Sindiya-Ba'quba line. This had caused the great flood we had been steaming against, and of course we gave up the idea of further progress that day.

THE TIGRIS BELOW DAUR

H.M.S. "CADDISFLY" AT QANTARA

From sketches by Lieut. E. Boosé (E. Hamilton).

DAUR

KADHIMAIN

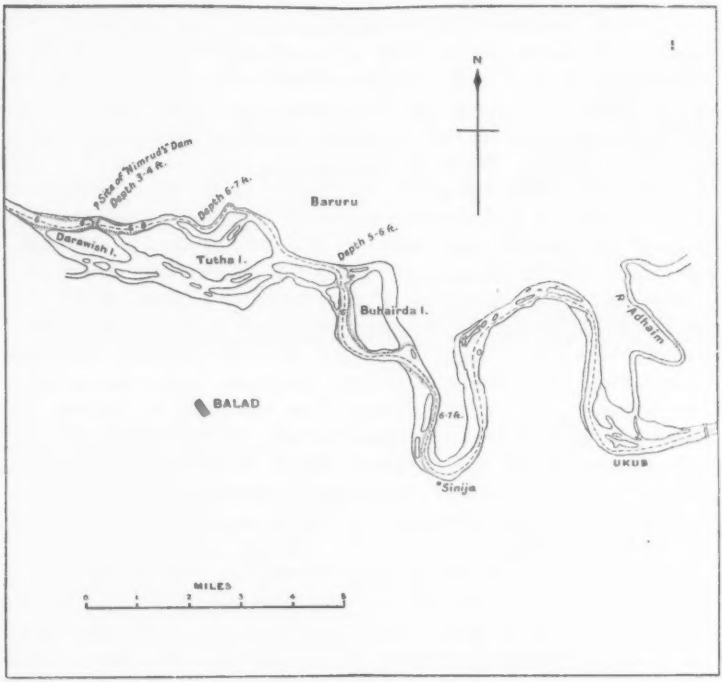
From sketches by Lieut. E. Dcosé (E. Hamilton).

Next morning we passed through, and after taking about eight hours to cover 17 miles, we reached Ukub and took over the duties of advanced gunboat from another "Fly"—the *Hoverfly*. She had had a pretty bad time, we found. The flood had swept her from her moorings, and with all her anchors down and engines going full speed ahead she had only just managed to escape being swept on to the wrecked pontoons. Moreover the present position was by no means comfortable. The cliffs below which the gunboats were moored rose up perpendicularly some 40 feet, and, undermined by the swirling current, were beginning to fall down, as periodical crashes, loud as thunder-claps and some of them alarmingly near, announced. As the opposite side was shoal water for some distance, and was in any case remote from headquarters, it was difficult to find a suitable and safe billet, though we determined to do so as soon as possible. Before the determination could be realized we had a narrow escape from wreckage. At 3.30 a.m. on the following night we were all awakened by a tremendous crash, and got up in time to see the bows of the gunboat, just visible in the dark, swinging away from the bank. All the forward part where the anchors were stowed, was covered with a huge heap of mud which had once belonged to the cliff. All the forward moorings had come away, and we were drifting down towards the wrecked bridge, though the moorings, dragging along the bottom, fortunately delayed our progress somewhat. In the vital necessity for economizing fuel at this distance from our base, we had not felt justified in keeping steam at immediate call, and we couldn't let any more anchors go till the mud was cleared away. Altogether things looked pretty bad. As luck would have it, however, we drifted into a backwater, and before we got out of it we had dug the anchors clear and got steam at command.

Nobody was in a particularly good temper when the daylight came, but the incident did in fact lead to a momentous decision. After breakfast I sent for the Engineer and said, "I'm fed up with this place. I'm going to Samarra to-morrow." It really seemed the only solution, and as a matter of fact it was the right moment. The river was "up," and that might make the bar passable, but it was beginning to fall, and so the bar would not be passable for long. On the other hand a falling river meant less current, and that might make the rapids navigable. It was however a leap into the unknown, and any mishap in those wild parts might have had unpleasant consequences; but to confirm the decision a small motor launch arrived that day under orders to explore a channel as far north as possible; her presence diminished the risk and we set out.

As we had anticipated, the current slacked a good deal after we had passed the mouth of the 'Adhaim, and we found navigation quite easy over a soft bottom for the first mile or so. The river was picturesque, with high cliffs, sharp bends and islets, but the country very bare and

almost treeless. The only landmark was the fine dome of Balad mosque, set off by a few scattered date palms; and here and there were primitive Arab encampments with patches of cultivated ground. Beyond Sinija we overtook and passed the motor launch which had got a mooring rope around her screw, but signalled that she did not require assistance. We were now approaching the part of the river where we anticipated difficulties, and would have been glad of the pilotage of a small craft,



Section 1: Ukub to Darawish.

but having started we were in no mood for waiting, and so decided to push on.

We had with us the Tigris Corps maps, which showed the lines of the banks but of course gave no information as to the channels. All we could derive from them was the fact that there were a good many channels at this point, and the problem was which to take. As we afterwards surmised, this state of the river is due to one of the many irrigation schemes which have been carried out from time immemorial in these parts. The so-called "bar," about which we had been warned, was in reality the remains of a great dam, said by some to have been built by Nimrud. Another rather dubious feature was the appearance of

shingly beaches, soon followed by shingly bottoms, as the grinding noise of the sounding poles announced, and this of course meant that grounding was going to be a much more serious matter.

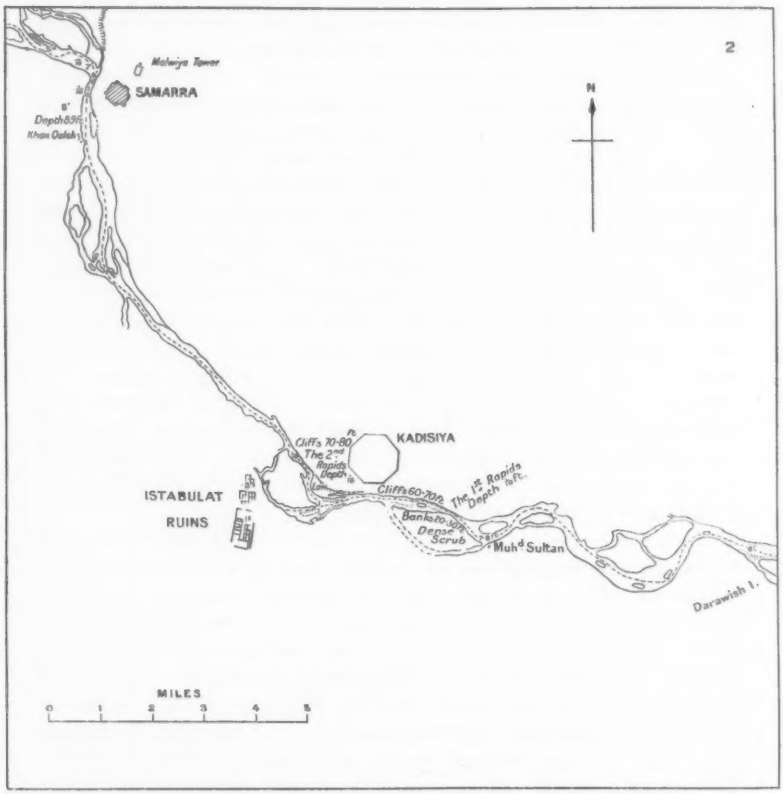
However we went on. Our experience on the river had given most of us a certain amount of "flair," and we moved along in—as a rule—from 6 to 7 feet of water. At one spot there was a remarkable D-shaped indentation in the bank, and we had to follow round the curve of the D. Some of us wondered how we should ever get down it again, going with the current. Not long afterwards we emerged from a deep narrow channel on to a broad open sheet of water, and the sounding poles soon confirmed the suspicion that we were approaching the shoals. This was in fact the famous Darawish bar, across which the Arab children had been seen to walk in the low season. It was an anxious moment for us. No vessel of our size had ever crossed it before (or since), and it was likely to be a hard and stubborn thing to strike. Soon the soundings dropped to 5 feet—to 4 feet. The engines were going full out, but we were only just gaining on the current, which ran very fast here. To add to our difficulties the stern, in the shallow water, settled down 3 or 4 inches, and presently the engineer came up to say that the propeller was knocking up stones into the tunnel in which it worked. With the engines doing about 30 revolutions above their designed speed we didn't know how the propeller would like it. Now the soundings dropped to 3 feet 6 inches. We thought we might as well go on till we stuck or something happened, and, as often on these occasions if only one does keep on, nothing happened; and presently came the welcome call from the sounders, "Four feet, 5 feet, —6 feet . . . " We were over, and we were going to get to Samarra, the first and only gunboat that ever did so.

Soon the river began to narrow again into a more natural course, and we left the wide expanse with its confused group of islands and channels behind us. Though we sometimes had difficulty in finding the fairway there were no more bars, and by 3 p.m. we had reached Muhammad Sultan. Originally we had intended to stop here, reconnoitre on foot the "rapids," which were said to be a little further on, and then walk over to Istabulat to arrange for haulage from the brigade there if it should be necessary or practicable. But as we had got on so well and the day was yet young, we thought we might as well push forward and have a look at the "rapids" from the gunboat; and the proposal suited the mood of the moment, for we were naturally well pleased with ourselves. Accordingly on we went.

The river now narrowed exceedingly, and was apparently very deep. The sounding poles went down their full length, 12 feet, and found no bottom. Soon we seemed to be approaching a regular gorge, almost dark and gloomy in spite of the bright sunshine. There was no sound of any rapids. On the left bank the cliffs rose up some 60 or 70 feet, and were studded with massive blocks of a conglomerate of granite shingle

cemented by a gypsum lime, of which latter we found abundant evidence later on in beds of crystals cropping up above the alluvial soil. Some of these blocks jutted right out into the river in an uncomfortable fashion, but fortunately we found none in the fairway, which meanwhile grew narrower and narrower, whilst the current began to run with great violence and to swirl and eddy about our bows.

Evidently this was the site of the "rapids," which according to reports



Section 2: Darawish to Samarra.

ran amongst broken rocks in the low season. Strange to say our sounding poles never once found bottom in the fairway, though we had abundant evidence later on of the fact that that bottom really was rocky. As we were barely moving we thought we could risk a bump, and in any case there was no room to turn round. The channel was barely 100 feet wide, and the current ran at 5 or 6 knots. The engines had to make a great effort, and responded nobly. The engineer claimed that they had

done 60 revolutions above their maximum that day, but even so at times we scarcely moved at all. It took us nearly an hour to advance about half a mile, and then just as the river seemed to be widening again, and we thought our troubles were over, we saw right in front a small island apparently completely blocking the fairway. There was a good wide expanse of water to the left, but it looked shallow and broken, whilst on the right there was no obvious passage at all. Boosé, the first lieutenant, went aloft and reported that there was a narrow channel on the right, so we tried it. It was barely 60 feet wide, and we touched on a shelving bank at the bend where we entered it, but came off without damage. It was obviously going to be a most unpleasant place coming down, but once through it we found that our troubles for the moment were ended. We emerged into a broad open reach where the current was comparatively moderate, and before us were the white tents of Istabulat, the first signs of civilization since we had left Ukub.

At Istabulat the river is again spread out and broken up into channels, and we proceeded for the night into the one that ran below the camp on the right bank, crossing a rather shallow mud bar on the way. Istabulat gave us a welcome as the first gunboat in those parts, but we were somewhat upset to hear that the river was falling rapidly, so that there was a danger of being locked in if we delayed too long.

The river continued to fall rapidly that night, and we got away as early as possible next morning. As it was we only just cleared the bar. We had been given to understand that there was a second set of rapids above Istabulat, but we received this information with equanimity now, and turned up the main channel which curved towards the left bank. Soon it took on the appearance of a gorge, similar to the one we had passed through on the previous day, and the current boiled swiftly through it. The cliffs were even finer here, towering up on the left bank, 80 or 90 feet, straight above us, and studded with nasty-looking blocks of conglomerate. There was one very sharp bend where the waters began to swirl and eddy and form backwaters in which the current ran quite swiftly upstream, whilst all the surface of the water was covered with a yellow scum. This was no doubt again the site of rapids, but here also there was apparently plenty of water, and though there were numerous eddies, we could not detect the characteristic disturbances caused by rocks near the surface. We kept on therefore, making what use we dared of the backwaters. The current in the main stream was very strong, but again the engines did not fail us. It took us, however, just an hour to clear that gorge, though it was a bare $\frac{1}{2}$ mile in length, but when we emerged at last we found ourselves in a wide open channel, and knew there were no further obstacles between us and our goal. We had been lucky. We had found just sufficient water for the bars, whilst the subsequent fall of the river, which had now made the bars impassable, had caused the current to ease up sufficiently to enable us to negotiate it.

One day before the current might have been too strong; a day later, and there would not have been enough water.

Before long we got our first view of Samarra, and it was really most impressive. The morning had been rainy, and the sky was still covered with heavy banks of clouds, but just as we opened the last, almost straight, reach the sun burst through, and its rays lit up what seemed to us like a veritable fairy castle, with towers and battlements standing high up on the left hand. By some effect of mirage it seemed to rise right up into the sky, suggesting the New Jerusalem of a mediæval Italian painter. This building, as we afterwards learned, was an ancient palace known as Al Ajik, or the Abode of Love. It is said to have been constructed by some Caliph for a favourite wife, but we never could get very authentic details about it, and I have not been able to find any information in the Library. There seems to have been a legend recalling that of Hero and Leander attached to it: the Muhammadan Leander having been in the habit of swimming across the Tigris nightly. If he did it speaks well for the strength of his illicit love, for the river with its various channels is about ½ a mile broad there and runs at 4 or 5 knots. Perhaps, however, he used a blown-out goatskin.

The building itself is square, and what we had mistaken for towers were really the remains of the massive brick pilasters of walls, the intervening portions of which had fallen away. It may have been beautiful when its courts were covered with marble, and the nightingales sang in the rose-bushes, but it is nought but a dismal and dusty ruin now, and perverted, when we saw it, to the base uses of war. One would like to know a little more of its history.

While we were still gazing at Al Ajik, the great golden dome of Samarra mosque burst on our view. As we saw it then it was most impressive with its flowing cusped curves and pointed pinnacle, and the intermittent sunlight flashing on its gilded surface. At that distance the rather sordid surroundings could not be distinguished. The smaller and older mosque not far from it is, as is probably well known, the more sacred. It is said to mark the spot where the 12th Imam, Muhammad al Mahdi, removed himself from the sight of mankind, and one gathers that he is still living in a well within it.

Beyond Samarra itself is the peculiar brick tower, with a spiral staircase contrived round the outside of it, known as the Malwiya tower. It is said to have been constructed in the eighth or ninth century A.D. as a minaret for the great mosque whose ruins are hard by, but I venture to suggest that this is a matter that calls for further inquiry. One understands that all so-called Arabic architecture really owes its inspiration to the Persians, but the whole style and appearance of this thing suggests Babylon. I am informed that its character is exactly that of the towers at Babylon and Birs Nimrud. It stands quite by itself, a good 50 yards away from the remains of the great square building which is variously

described as a mosque or a caravanserai. I have never seen a minaret of similar structure, or thus separated from the main building. The minaret of the mosque of Tulun at Cairo, which is said to be an imitation of it, may indeed have been suggested by our tower, but it is really of very different structure and appearance. Moreover the building of this tower is quite different from that of the other ruins round about, and though it may well have been used as a minaret, I should like to know what definite. proof there is that it was not there long before the Arabs came.

I heard a rather frivolous legend as to its origin, which does, however, suggest that the Arabs themselves thought that its rather unorthodox appearance required explanation. It relates that the Caliph Harun was pondering one day what shape he should give to the minaret he was purposing to build. He pondered so hard that he fell asleep and would have missed the hour of prayer had not a strange old man suddenly appeared, seized a roll of parchment and twisted it as a grocer will a paper cone, which he set down on its base, and then vanished. The Caliph woke up, said his prayers, and accepted the omen.

From the top of the tower one gets a fine view over the Nahrwan canal to the Jabal Hamrin. A conspicuous object is the great mound known as Tall Alij, or Julian's Tomb. It must surely have been there before Julian's time. One supposes that the soldiers of Julian's retreating army saw it, and deposited the body there, but I do not know what authority there is for the name at all. We may perhaps discount Libanius' story that he was killed by a Christian soldier, and the disaffection that it suggests; but we can hardly believe that retreating soldiers, however much they may have loved their Emperor, would have delayed to pile up a mound of that size. It is some 70 feet high and about 150 yards in diameter at the base.

Running from the tomb towards Samarra is a kind of underground conduit, supplied by large circular bricked openings, designed to collect the surface water. We saw only this one example of this kind of structure. Of the ruins of Eski Baghdad the Bait al Khalifa is the most conspicuous. It has a large arched hall which seems to have been copied on a small scale from the Hall of Audience of Ctesiphon, and I must repeat that all these ruins, as regards style and structure, give a totally different impression from that obtained from the Malwiyah tower.

We had plenty of time to explore all these things, but of course when we first arrived the chief business was to discover a suitable position where our armament would be of use in case of an attack. Owing to the configuration of the cliffs on the left bank such a position could be found only some 3 miles above the town, where the river is wider and the cliffs fall away. Unfortunately there were three several difficulties in the way. There was the pontoon bridge which carried the supplies from the terminus of the Baghdad railway to the brigades on the left bank, and

which had not been designed with an eye to the needs of navigation; there was also a wire boom which had been constructed by the R.E. to hold up floating mines which the Turks had thoughtfully dropped into the river higher up; and there was finally what was described as a narrow rocky ledge running right across the river with only a couple of feet or less of water on it. As a matter of fact this ledge was but the

Section 3: Samarra to Qantara.

remains of another of those ancient dams such as were said to have been constructed by the enterprising Nimrud.

With a view to exploring this dangerous ledge, we succeeded in borrowing the only boat in the place—a small motor-boat which had been sent up by rail from Baghdad for the use of the bridging officer. It was in a decidedly shaky state, as there was no proper workshop handy. In particular the pipe which carried the cooling-water round the cylinders leaked into the sparking arrangements, causing a good deal of "missing."

In this craft, nevertheless, we managed to reach the ledge, and discovered that there was a deep passage through it. It was not however possible to make a proper examination in a single boat in that current, and over-confidence nearly brought about disaster.

Having reported satisfactorily and arranged for the opening of the bridge and the lowering of the boom, we proceeded one afternoon to take up the new position. All went well till we came to the dam; we could see the line of it on the left hand, and then an obviously clear stretch to the beach of the island on our right; but in that seemingly clear stretch there was just one pinnacle left of the old brickwork, and of course we ran on to it, breaking it off apparently, but getting holed ourselves beneath the fore compartments in the process. Soon we found that there was nothing to be done but beach on the island on our right, and there we spent the night, cut off by the width of the channel from the camp, and a little anxious lest we should, in our exposed position, become a target for bombing raiders, of whom a few appeared from time to time. We were certainly in a nasty position, 600 miles from dock or slip, and Nimrud, if his ghost had been around, would have heard no complimentary things about himself, but we managed to pull ourselves out of the scrape. The full details of how we "made good" would only be wearisome. Suffice it to say that we first secured No. 2 bulkhead with cement and shores, and then with the aid of a German pump, part of the spoil of the last advance, we got the water down sufficiently in the foremost compartments to be enabled to explore them. We reduced the volume of water by packing them with empty oil-drums, wedged down, and then built up a coffer-dam over the hole, using bags of shingle to hold down the packing.

We had beached on a Saturday evening, and by the Monday night the work was done sufficiently to enable us to haul off on the following morning and take up the position originally assigned to us. Some finishing touches were required, and when things had settled down we only made an inch or two of water a day in those compartments, a matter of a few minutes' pumping: a remarkably good piece of work, considering the conditions and our resources, and one reflecting great credit on Ship-wright Leach and Engine-Room Artificer Reg. Blick, who took a leading part in it.

Things were now quiet enough. The river continued falling, and the expected attack did not come off. People began to talk about an advance, and one day we were sent for and asked if, when the spring rise of the river began, we would endeavour to survey the river as far as Tikrit with a view to seeing if it were practicable for water transport. The motor-boat was to be placed at our disposal, and escorts of cavalry would guard the banks to keep off snipers when the time came.

We made our plans and preparations, and did a little preliminary exploring, but it was soon clear that the motor-boat would not take us very far. Our plan accordingly was for the gunboat to venture up herself

so as to form each day an advancing base from which the motor-boat could work a section of the river at a time, though it would be rather a ticklish job to navigate a comparatively large vessel in those unknown waters, with their hard bottoms, and possibly hidden rocks, contact with which might well bring real disaster.

Before beginning the account of our survey work, I should like to describe the local method of catching fish, which is rather peculiar, and which I don't remember having seen described before. The stony bottoms in these parts render unsuitable the throwing-net which is used lower down the river. The natives therefore lay down a ground-bait of lumps of dough with a small quantity of opium. The fish swallow this, and becoming stupefied, float about on the surface with their white bellies uppermost betraying them. The Arabs go in pursuit on a blown-out sheepskin, which they manœuvre with their feet, whilst the hands are free to hold the landing-net. A strange-enough sight these wild fishermen are, as they lie on their bellies on the floats, with their robes tucked round their waists, and drift away down stream on the look-out for a quarry; paddling frantically with their bare brown legs when they sight one. Hardy fellows they must be, too, for the water is icy cold in the winter. We used the dinghy, though sometimes the fish passed close enough to be gathered from the gunboat.

There was still a longish period of waiting before the river rose, but at last it came to an end. The moment was signalized by a terrific downpour, which must have washed away the softening snow in the Armenian mountains, and it brought down the river in flood. Just as at Ukub, and almost at the same hour of the morning, we were swept from our moorings and nearly carried on to Nimrud's confounded dam. Fortunately there was no fall of the cliff, and we were able to let go all our anchors and fetch up in time. Then on February 27 we got orders to make a start the following day. The cavalry escorts were being sent out, and we were to have a week to explore the 40 miles or so to Tikrit.

We set out next day, the motor-boat going in front. We took with us the Army T. C. maps, which were constructed on a scale of 1 inch to the mile, and of which we had made enlargements, in sections, to a scale of 6 inches to the mile. Our great difficulty was to find out whereabouts on the map we were. Near Samarra itself we could get a few fixes from Al Ajik and the Malwiya tower, but when they could no longer be seen there was, for considerable sections, practically nothing to go upon in the way of landmarks. The chief guides were the bends in the banks, and by taking sextant angles of these, and comparing them with the angles of the bends on the map one gradually worked the different positions in. Of course there were always definite checks at places like Qantara and Daur. After each day's work in the motor-boat the rough charts of that section were left in the gunboat when she came up over it the following day, and as a good view could be got from her bridge, it

was possible to verify the results with sufficient accuracy for practical purposes.

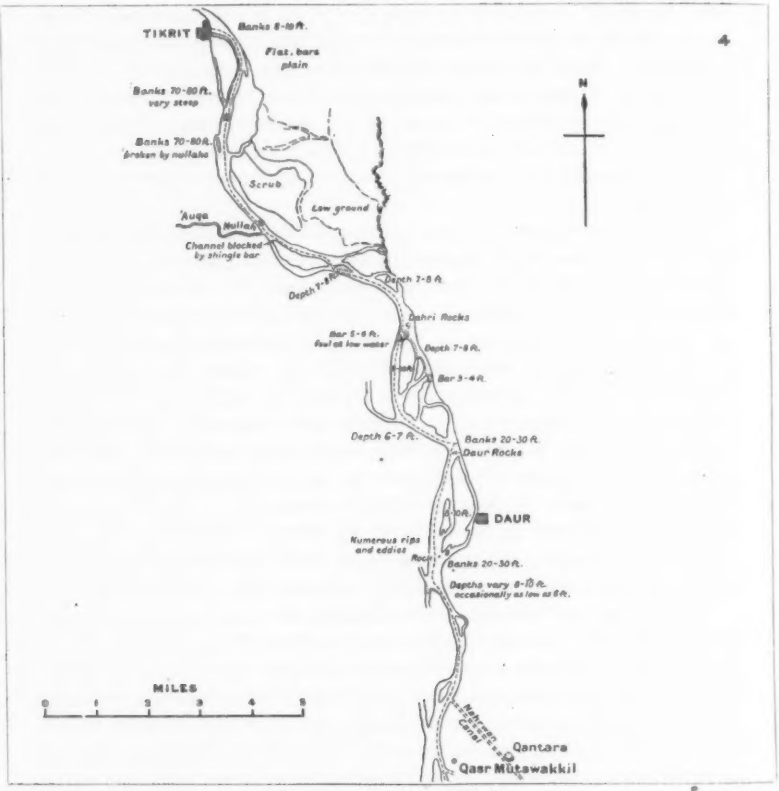
The soundings were taken with a 10-foot pole, which was about as long as a man could handle in a small boat in a swift current, so that depths beyond that were not recorded. Above Huwaislat, however, we anchored, and tried to get a kind of "deep-sea" cast with the crew ranged along the gangway of the gunboat. We were unable to get any satisfactory result, and a 15-foot pole put down did not reach bottom. I should judge the depth to have been over 20 feet there in the then state of the river. All soundings were reduced to a standard reading of a river gauge at Samarra. These readings were always a matter of daily record, and on this occasion arrangements were made for our escorts to lay a field telegraph, and by means of it we got the readings every evening and reduced our soundings accordingly. Where we did reach bottom it was nearly always hard or shingly, though occasionally there were some soft patches.

At the moment when we first left Samarra our chief anxiety was with regard to a bar just above Huwaislat, which we had discovered with only 2 feet on it in one of the preliminary explorations. It was apparently another of Nimrud's intolerable dams; at any rate it was he who had set the evil example. We got to Huwaislat without mishap, though the course of the fairway was sufficiently intricate. Then the motor-boat went on to Qantara, taking most of the day to explore the channel. There was an advanced post at Qantara, and news was received there that the river was falling. As there were only 4 feet of water on Huwaislat bar, this was serious in view of the fact that the work had to be done in a week. It was accordingly necessary to come back and take the gunboat over the bar in the dark. It was a near thing, and, as a matter of fact, gauge readings for the next three days showed that there would have been less than 3 feet there. After that the river rose again.

Beyond the bar the river narrowed again to a more natural course, and there were no special difficulties except at a nasty bend above Jubur. On the right hand the banks began to rise into quite imposing cliffs, 70 to 80 feet high, with fine projecting bluffs. Their tops are crowned with the ruins of the great city of Mutawakkil, "he who trusts in God," the Orthodox Caliph, who persecuted heretics and unbelievers, and by his remarkable bureaucratic organizations seems to have anticipated those modern developments which we count amongst our present afflictions.

A little above Qantara the great Nahrwan canal leaves the Tigris for its long, and at one time beneficent, journey across the desert. After this there was little of general interest until Daur was sighted. It is but a huddled little town of low Arab houses now, with an ancient brick tomb—called Imam-ad-Daur—of the sugar-loaf pattern, with alternated convex flutings, which makes a good landmark. All around the country is as bare and desolate as can be. We did not see a tree in the place, and

scarcely even a bit of scrub. One wonders not only what the people live on, but why they live at all! On the other hand, there is plenty of evidence of the life that exists in the grim bosom of the upper Mesopotamian desert. Ordinarily it is a surface of hard-baked mud, so hard and dead to all appearance that one cannot conceive the possibility of any life in it. But the occasional downpours bring up, as it were by magic, quite a crop of small bright flowers. One hardly notices them at first,



Section 4: Qantara to Tikrit.

they are so small and coy, but in time one sees them everywhere, even quite far out in the desert. There were ground orchids and a kind of asphodel, various species of the heath and stonecrop families, and a good many which lay beyond the range of our botanical knowledge. To those who know the heat and dryness that exist for eight months of the year it seems extraordinary that the seeds and roots can keep life in them, but the phenomenon is surely of good augury for future agricultural development.

The Sheikh of Daur was said to be friendly, but in any case we were well covered by the mounted patrols on either bank. There is a narrow and fairly deep channel running close up to the town, and the natives used to make brushwood rafts which were loaded there and floated downstream. Partly, no doubt, in consequence, there was very little brushwood about, so the "sea-borne trade" must have been rather stagnant.

The main channel of this reach was a good broad one, with subsidiary branches running through the islands, but its chief feature is a number of genuine rocks scattered about, most of them partly submerged in the then state of the river. They are all of the same kind of conglomerate that we had remarked on the cliffs lower down, but this was the first time we had seen them in the bed of the river. A peculiar phenomenon which gave us a good deal of anxiety was the appearance of numerous tide-rips and eddies, sometimes stretching right across the fairway. We naturally thought they were caused by rocks, and concluded at first that our trip was over. Careful examination, however, showed that it was not so, and that the fairway was quite clear. We could not account for the eddies, some of which formed distinct craters from 12 to 18 inches wide. It was evidently no place for a swim. We had not, however, finished with rocks, for above Daur there is a formidable yet picturesque ring of them, standing out of the water in black masses with jagged edges. In view of the way in which the river was spread out below them, we had a suspicion that our friend Nimrud had been at work here too.

The gunboat got up above Daur without difficulty. In the next section the river was again spread out, and accordingly we began to look out for another dam, and we did in fact find what may have been the remains of one. After proceeding in 10 feet or more for some time we came to a regular ledge, which we traced right across the two main channels. It was quite narrow, and had not more than 3 to 4 feet on it. As the river had begun to rise again and was well up, we marked it as a probable ford at low water. It may have been near here that Jovian's army crossed the Tigris in its retreat. A little further on was another formidable ring known as Dahri rocks.

Generally the scenery between Daur and Tikrit was fairly picturesque with reedy islets and shingly patches, set off by occasionally high and rugged cliffs split by deep dry nullahs. It was terribly desolate, and when we climbed up some of the nullahs to get a view there was nothing to be seen but a few scattered herds and goats. Occasionally an armed Arab stood and watched us from the bank, but there was no sniping and we were always comforted by glimpses of our cavalry escorts. Our worst anxiety was with regard to the boat. The engine began to miss rather frequently, and usually at very inopportune times.

At one point, and at one point only, our eyes were gladdened by a real belt of scrub. Later on, after the work was over, we met one of the escorts there, and that patch was thoroughly beaten out by a hundred

Indian Lancers. It was stiff with black partridges, and we could but sigh at having no more than two guns.

The final section which we explored, to Tikrit, was quite straight and easy, and continued to be so beyond, so far as we could see. Tikrit itself stands picturesquely enough on the right bank, its grey square-topped houses rising in tiers till they crown the high cliffs, with whose colour and general outlines they blend so perfectly as to be almost invisible. The mosque, which lies down near the river-bank, has a spherical dome without minaret; and the absence of this feature helped to make the place, from afar and beneath the deep blue sky, look rather like one of the Italian cities of the Apennines. But as we got nearer the illusion faded. How sadly it wanted a bit of green! We saw but one tree in the place—a melancholy-looking date palm—situated in a walled "garden." Even the picturesqueness faded on closer acquaintance. It was a dirty, smelly little hole, though the natives themselves, and even the children, were perhaps cleaner and better dressed than usual. The latter wore brightly coloured prints which might have come, and probably did, from Manchester, whilst some of the more important-looking Arabs had fine gold-embroidered abbas. The women, of course, were veiled, though it is to be feared that some of us were favoured with glimpses of fair faces looking down from balconies and housetops. Handsome faces they were too, some of them, though spoiled by the dyed eyebrows and the black henna rings round the eyes.

It is now time to sum up on the feasibility of navigation in these parts. If it were not for the existence of those ancient dams, or what we have supposed to be such, there seems no reason why good-sized craft drawing 4 to 5 feet should not navigate the upper reaches during a considerable part of the year, if not indeed all the year round. As the channels are very intricate, and as buoys will not easily hold on the shingly bottoms, and would in any case be misleading with the constant changes in the height of the river, charts would be necessary. The channels are certainly fairly permanent, and re-surveys would not be required more than once a year at the most. It would be desirable to have what I may call "identification" marks placed along the banks so as to obviate the already mentioned difficulty of knowing where you are. It should be noted that the obstructing dams are all narrow, and passages could probably be cleared through them at small expense.

On the other hand it may be that the prosperity and future development of the country will be best served by reconstructing the dams rather than by completing their destruction; and it may well seem, too, that unless the land is made fertile there will be little call for navigation there; yet again, if oil-fields are developed, the question of river transport may come to be of importance.

These considerations of course did not, at the time, influence our work,

which was carried out for military reasons, and had also, it should be remembered, to be done in a limited time. Having completed it we had to consider the question of getting down stream again. We had just been sharply reminded of it by the unexpected receipt of orders to return to Baghdad and pay off, as all available officers and men were to be sent home to cope with the submarine peril. At the moment we were rather disgusted, but apart from these feelings we knew that the descent was going to be no light task. It was essential to have some device for holding the stern steady as we ran down the swift and narrow channels. At first we tried towing a kedge anchor astern, but soon lost it, and ultimately the problem was solved by using a large iron oil-drum in the same way. The first was also lost before long, but the second survived the rapids, and was photographed when we got to Basra. Its appearance afforded satisfactory evidence of the solid and jagged nature of the bottom of those rapids.

Even with this assistance the return journey was not without incident. Our first difficulty was at the awkward Jubur bend, where three times we had to turn round hastily to avoid being swept on to the shoal which lay in the centre of the channel. In the end, observing that the beach on the right bank just beyond the turn was soft, we ran the nose of the gunboat deliberately on to it, and then with some toil laid out warps and hauled the stern round till she lay parallel to the channel. Below Huwaislat we had a worse mishap, being carried on to the point of the shoal just where the channel divides. Every attempt to haul off with anchors laid on the shingly bottom failed. Our small anchors would not grip. As a last resource we sent the motor-boat down to fetch up the largest pontoon grapnel procurable. The motor was literally at its last gasp, and just as the boat came back from its successful errand the joint of the circulator gave out altogether, so we had no means of laying out the quite satisfactory article which it had brought.

We tried carrying it out by hand, but it was too risky to go anywhere deep, the men could scarcely manage the heavy thing in the swift current, and the water was very cold. After three days of this our engineers managed to make a patch-up of the pipe, and after about three failures or breakdowns, the boat got away. It managed to drop the grapnel in a fairly good place, and was then ignominiously hauled back by the tow-line that we had taken the precaution to attach to its stern.

After this we decided to wait for a rise. We knew that if we pulled that grapnel in, in trying to get off, we should never get it out again. On the eighth day after grounding the rise came, and having gingerly tautened our grapnel-line, we fortunately swung off into the channel in the early morning, and after some difficulties, accentuated by the darkness and a mist that most unfortunately arose, we got clear and ran back to Samarra without further mishap.

Then came the rapids. We did in fact find them sufficiently hair-

raising, especially in the narrow passage of the second set. We ran past the uncomfortably close cliffs with their jagged protuberances at about 14 knots, of which the current accounted for about 6. Naturally the boat did not answer her helm too well. Our oil drum saved the situation, and the sharp continuous jerking astern as the improvised anchor bit into the rocky bottom, did serve to keep the bows in the right direction, but every jerk brought with it a qualm as to whether drum or cable would stand the racket. Fortunately we had a 5-inch wire for the latter, and the slings were of the same material, and though we did, as has been said, lose a drum, it was not in a critical place. The D curve at Barurah was, as we had anticipated, a nasty piece of work. We actually grounded pretty hard, but got off without great delay, and soon after we had reached the soft part of the river, and could feel that we were really on the way home.

Before the paper the PRESIDENT said: I have very much pleasure in introducing to you the lecturer this evening, Commander Elwell-Sutton. He commanded a gunboat on the Tigris during the war, and I hope he will give us his experiences not only of the gunboat but also generally of that country, and tell us what it was like when it was 136° in the shade.

Lieut.-Commander A. S. Elwell-Sutton then read the paper printed above.

The PRESIDENT: I am sure we shall all have gathered that this feat of getting what looked, from the pictures, rather like a battleship right up above Samarra and through those rapids was a very wonderful performance. It could only have been carried through with the enterprise, resourcefulness, energy, and skill that the lecturer must have possessed. I was interested to hear of the sudden flooding that occurred. The lecturer said that one cause of it was the mountain sides being swept into one of the tributaries of the Tigris, and also the heavy rainfall up in the Armenian hills. In the Himalayas one gets very accustomed to this kind of thing, for there, every now and then, a whole mountain side comes down into the Indus, or one of its tributaries, and blocks it for several months till a large lake is formed, and then the volume of water is so increased that this temporary dam bursts and a tremendous flood comes rushing down the Indus valley and bursts out on to the plains of India. For fifty or sixty years that has been happening, and there are huge tracts of land overrun with water, villages and towns having been swept away. There are many such cases on record. It struck me on hearing this account of what happens in this old Biblical land that possibly the story of the Flood might have originated in some great flood such as those of which we have heard. I do not know what the Armenian mountains are like, but it is just possible that on some occasion a huge landslip may have dammed the upper waters of the Tigris or its tributaries for some months, and then instead of a rise of only 2 feet there may have been a rise of many feet, such as one sees in the Indus, and huge tracks of land may have been flooded over and villages and towns swept away, the only means of getting about being in an ark. I am sure you will all wish me to thank the lecturer for the very graphic way in which he has given the account of this very enterprising trip up the Tigris.

THE PHYSIOGRAPHY OF SIERRA LEONE

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(Communicated by permission of the Secretary of State for the Colonies.)

Read at the Afternoon Meeting of the Society, 14 *November* 1921. *Map following p.* 96.

1. Introduction.

THE territory of Sierra Leone is on the West Coast of Africa, between 6° 55′ and 10° N. lat. and 10° 16′ and 13° 19′ W. long. It comprises a Colony and a Protectorate, with a total area of about 27,300 square miles. The Colony lies along the coast, and consists mainly of a mountainous peninsula 25 miles in length and about 14 miles in mean width.

No general topographical survey of the territory has ever been made, and the only portions which have been at all accurately surveyed are the peninsula of Sierra Leone as far east as Songo Town and the greater part of the international boundaries. Practically all other detail given in the published maps has been obtained from sketches made by various officials from time to time. These maps, while invaluable in the absence of a general survey, often give an imperfect and even inaccurate idea of the topography of the country; moreover, they sometimes show considerable distortion of distances. An attempt has been made in the map that accompanies this paper to give an outline of the physiography of the country, and to show its relation to that of neighbouring areas. The information thus given has been obtained from numerous aneroid observations made by the writer, supplemented by a few heights set forth on the published maps.

The Protectorate may be regarded as consisting of a low-lying coastal plain and of a more or less mountainous upland area which forms a continuation of the Fouta Djallon massif. It is proposed in this paper to describe the essential characters of these physiographical divisions, together with those of the Colony. The coastal plain extends over about one-half of the Protectorate; it has been developed by an intermittent uplift of late geological age. The upland area consists of a great series of crystalline plateaux which range from about 1000 feet above sea-level to over 6000 feet. These plateaux are overlain by an uncompacted sandy formation, which is closely analogous in field character to the "drift" of Northern Nigeria. This formation has been carved into a series of terraces, and evidence will be brought forward to show that these terraces were produced by marine erosion in the course of an intermittent uplift which has operated through late Tertiary times almost down to the present day.

The rocks underlying the coastal plain consist of a series of ancient schists and gneisses, and of a series of old highly-folded sedimentary and volcanic rocks: the schists and gneisses, which underlie the sedimentary

and volcanic rocks over the inner portion of the plain, outcrop over a broad belt that extends along the coast. The upland area, on the other hand, is made up essentially of a great series of granites and related rocks. The great development of horizontal sandstones which extends over a large part of French Guinea is not represented in Sierra Leone, except that for a short distance along the north-east frontier near Saionia they form a high scarp overlooking the inner margin of the coastal plain.

The Colony is geographically and geologically distinct from the Protectorate. It consists of a mountainous peninsula which rises abruptly from the seaward margin of the coastal plain; the mountains, which rise to a height of nearly 3000 feet, have been carved out of a great mass of gabbro (norite), and they show a series of high plateaux analogous to those of the upland area of the Protectorate.

2. The Coastal Plain.

The inner margin of the great coastal plain generally reaches a height of 400 to 450 feet, where it is terminated by the more or less well-defined scarp of the upland country, or by irregular hilly country; locally, however, this plain gives way to larger or smaller remnants of an earlier coastal plain which attains a maximum altitude of about 750 feet, and the passage from one to the other, although locally marked by low hilly country, is not infrequently defined by an abrupt scarp or old cliff. Moreover, there are remnants of at least one other coastal plain intermediate between these two, besides several minor platforms cut into the 400-foot platform,* as has already been described in the case of the Colony (I, p. 112).† In the present paper the term "coastal plain," where not otherwise defined, will refer to the whole complex coastal region, that attains a maximum altitude of about 750 feet. This low-lying coastal region extends into neighbouring and more distant parts of Liberia.‡ The relations of the different platforms of the great coastal plain of Sierra Leone both to each other and to the upland country will be described in more detail below.

The greater part of the coastal plain has been carved out of an ancient series of schists and gneisses and an old system of sedimentary and volcanic rocks (Rokell River Series); it has, however, transgressed inland on all sides beyond the outcrops of these rocks on to that of the Younger Granites.§ Conditions are similar in adjacent parts of French Guinea,‖

* Cf. the marine terraces of the Gold Coast, A. E. Kitson, "The Gold Coast," *Geog. Journ.*, 1916, p. 370.

† The numbers enclosed in brackets in this way refer to the list of papers on Sierra Leone appended below.

‡ J. Parkinson, "The Petrology and Physiography of Western Liberia," *O.J.G.S.*, 1918, p. 313.

§ For a summary account of the geology of Sierra Leone, see F. Dixey, 'Rep. Geol. Surv. Sierra Leone,' 1921.

‖ See J. Chautard, 'Étude Géophysique et Géologique sur Fouta Djallon,' Paris, 1905, p. 83.

since, as may be seen from the map, the coastal plain, following the outcrop of the Rokell River Series, has deeply indented the plateau country in the neighbourhood of the Anglo-French boundary, along the upper Great Skarsies river. In Liberia this series of sedimentary rocks is apparently absent, and consequently the plain does not penetrate so far inland. It may be mentioned also that in the neighbourhood of Sierra Leone and adjacent countries the sea is very shallow, since depths of 10 fathoms rarely occur within 30 miles of the shore.

It is possible in some localities to travel many miles over the plain without seeing any sign of the underlying solid rocks. There is good reason to suppose, however, that in such areas these rocks are rarely overlain to any great depth, because in adjacent areas they frequently reach the surface of the plain in the form of low slightly convex hummocks, or rise above the plain as hills of varying height. Moreover, the rocks are exposed at fairly frequent intervals in the beds of the rivers and larger streams, while it is a remarkable fact that at or near the tidal limits of every river that crosses the plain, and at the head of many creeks, the country rocks form rapids or low waterfalls. Also, a rock platform about 3 to 5 feet in height can be traced all around the shores of the Colony; it is readily recognizable from the approaches to Freetown Harbour. As examples of low waterfalls that stand 3 or 4 feet above high-water level in the lower courses of the rivers may be mentioned respectively those at Kambia, on the Great Skarsies river, at Rokon on the Rokell River, at Rotifunk on the Bumpe river, and above Mattru on the Taia or Jong river; very often rapids and occasional crags may be found below the falls. In all cases the waterfall is aligned parallel to the foliation of the crystalline rocks.

The surface of the plain is on the whole gently undulating, but within the neighbourhood of the larger rivers the undulations increase in frequency and intensity, while the rivers themselves often flow in gorges cut through the superficial deposits and, occasionally, even through the underlying solid rocks. These gorges are best developed on the narrow coastal plain that fringes the Colony, and many of them may be seen to advantage as they are crossed by the railway running from Freetown to Waterloo.* In many places, however, the plain is amazingly flat over large areas, as on the landward side of Port Lokko. Owing to the general low relief and the absence of appreciable gradients much swampy ground exists during a large part of the year, while the country is locally subject to extensive flooding in the rainy season; the rivers overflow their low banks and more or less completely inundate the country for miles around, so that travelling becomes a matter of great difficulty, or even an impossibility. The country near the Mabole river, for many miles above and below Batkana, is particularly subject to flooding of this kind. An attempt is shortly to be made in the lower courses of certain

* See I, p. 113, with Plate VII., showing gorge of the Orugn River.

of the rivers to utilize these and similar conditions for rice-growing on a large scale; the scheme has great chance of success, and it should prove an immense boon to the country.

The seaward margin of the plain between the peninsula and Liberia is fringed by a broad strip of littoral accumulations that are probably of Recent age; these accumulations often terminate against low cliffs, 10 to 15 feet in height, which are now set back many miles from the sea. Such cliffs may readily be recognized several miles north of Mano Sulija, near the mouth of the Mano river, and 5 miles north of Dibbia, near the mouth of the Moa river. The littoral deposits consist of numerous sand ridges which have grown up successively one in front of the other, and also of silted-up lagoons that have been cut off by the growing storm beaches; they are now overgrown by countless palms and patches of dense bush. These processes are still in operation in various places along the coast; they are particularly well displayed along the Bullom shore and also around the coast of the peninsula * (I, p. 116).

In addition to the Recent littoral accumulations just described, there are along the coast between the Peninsula and Liberia certain other deposits that form enormous areas rising only a few feet above high-water level; amongst these may be mentioned Sherbro Island and Turner's Peninsula, which are respectively about 230 and 290 square miles in area, and also several groups of small islands, such as the Turtle Islands and the Plantain Islands. These areas are made up essentially of sand and silt, and the only hard rocks known to occur on them are patches of ferruginous sandstone, due to the cementation of sand-grains by iron oxides. It will be seen from the map that Sherbro Island lies close to the mainland opposite the mouth of the Taia river and the mouths of several smaller rivers; moreover, Turner's Peninsula is directly opposite the mouth of the Sewa river, the longest river in the Protectorate, and it extends along the shore at a short distance from the mainland for as much as 30 miles on either side of the river's mouth. These islands, for Turner's Peninsula is actually an island, together with adjacent parts of the mainland, may be regarded essentially as upraised deltaic deposits, although, as is evidenced mainly by the even seaward shorelines of Sherbro Island and Turner's Peninsula, they have been much modified by accumulations due to littoral agencies acting subsequent to the uplift.

It is very probable also that the country north of Freetown, known as the Bullom Shore, originated in a manner similar to that of Sherbro Island and Turner's Peninsula. A large part of the Bullom Shore, however, rises to a height of 40 to 60 feet above the sea-level; this greater altitude, as compared with the other areas just referred to, is doubtless due to the greater thickness of sediment laid down by the four rivers which even now converge towards this area. Moreover, the

* Similar processes are at work in some localities along the shores of the Gold Coast: see A. E. Kitson, *op. cit.*, p. 371.

Bullom Shore differs from the coast on the other side of the Peninsula in that it is on the whole the scene of active marine erosion rather than deposition.* The projecting portions of the Bullom Shore are being so vigorously attacked by the waves that they form a series of almost vertical, naked cliffs which are often more than 50 feet in height. Large falls frequently take place along these cliffs, so that at any time trees of all sizes may be seen precariously perched on the edge of the cliff or lying prone on the beach below, while villages situated on the cliffs gradually retreat before the advance of the encroaching sea. This destruction of the Bullom Shore has been going on long enough to permit of the formation of an erosion platform which at low water can be seen stretching away seawards far from the foot of the cliffs. Standing out of this platform and forming islands in the shallow water are large masses of coarse porous laterite ("lateritite") and ferruginous sands that have proved sufficiently resistant to defy for a time the action of the waves; these masses are remnants of the thick hard crust which forms the upper portion of the cliffs. The projecting spurs along the coast, however, are linked up by long storm-beaches consisting of the débris worn from neighbouring cliffs; behind these ridges at varying distances are old cliffs that are now clothed in dense vegetation, while between these cliffs and the ridges lie narrow lagoons in various stages of growth and silting-up. Processes of erosion and accumulation similar to these may be seen in action along the shores of the Peninsula. East and north-east of the Bullom Shore, as near Port Lokko and Kambia for instance, the surface of the country rises gradually from a height of about 100 feet above sea-level to about 400 feet at Saionia, near the inner margin of the plain.

It has already been seen that the coastal plain is built up of a series of young sediments resting upon a platform of crystalline, sedimentary, and volcanic rocks. The thickness of these sediments is rarely more than 100 feet, while it is often much less; in fact, the rock platform itself is sometimes exposed over considerable areas. Locally, however, where the sediments extend over ancient valleys in the older rocks, as in the neighbourhood of Freetown, they may attain to a thickness of several hundred feet. The deposits consist of bedded sands and clays, associated in various proportions; lateritic gravels, cemented gravel ("pisolite-cement"), and laterite have formed on the surface of the deposits.

The thick hard crust of laterite and cemented lateritic débris resting upon the sands and clays has, as a result of the partial removal of the uncompacted underlying deposits, given rise to a variety of caves, besides causing many streams to follow underground courses of variable length.

The marine deposits are best exposed in the cliffs of the Bullom Shore; they may be seen also in the cliffs and river-beds near Freetown, and in some old cliffs near Taiama, on the upper tidal reaches of the Jong

* Cf. conditions along shores of Gold Coast: see A. E. Kitson, *op. cit.*, p. 371.

or Taia river (see papers I, VI, and VIII). They consist of sands, variably felspathic, interbedded with seams of clay and clay-sand. The marine beds of the plain are overlain by patches of fluvial and lacustrine clays,* sands, and gravels.

It has already been seen that in addition to the main platform that attains a maximum height of about 400 feet above sea-level, there are several higher platforms of greater age. These various platforms will now be considered in more detail.

The older platforms are represented by flat-topped hills and ridges scattered over the main platform, and also by elevated areas of considerable extent that intervene between the inner margin of this platform and the ancient crystalline plateaux. The flat summits of the hills range from a few hundred yards to several miles in length, whereas the ridges sometimes traverse the main platform for many miles. All the platforms slope gently seawards, but they will be named, like the main platform, according to their maximum altitudes. The following platforms have been recognized:

1. 700-*foot platform.*—This platform forms a long ridge and several low plateaux in the neighbourhood of Fodea near the Upper Skarsies river, a series of small plateaux along the foot of the Saionia scarp, an elevated tract along the southern side of the Lokko mountains, the Messeri hills, certain hills between Moyamba and Makassi, and a number of low hills in the Colony. It forms also a large elevated area about 45 miles long and 25 miles wide around the eastern terminus of the main railway line (Pendembu District), besides also another area of smaller size between Yatea and the Kabba river (north-eastern Karina District).

Rising above even this highest plateau of the coastal plain there are the yet older plateaux of the crystalline uplands; these older plateaux are represented over the area now considered by high flat-topped hills and groups of peaks, amongst which may be mentioned Makene hill, the Malal hills, and the Moyamba hills, some of which attain a height of 900 to 1000 feet above sea-level. Indeed, the Lokko mountains themselves, attaining a height of more than 1250 feet, may be regarded as an outlying portion of the great Koinadugu plateau.

2. 525-*foot platform.*—This platform gives rise to hills near Kambia, Karina, Wongkufu, in the Pendembu-Kotohun area (south of the Lokko mountains), near Makump, between Moyamba and Makassi, and in the Colony, besides in many other localities.

3. 450-*foot platform.*—A few small flat-topped hills have been noted rising about 50 feet above the general level of the plain, as at Batkana and also at Mapemma, a few miles above Batkana on the Mabole river: moreover, around the foot of certain hills, such as Makene hill near the W.A.F.F. barracks, and along the sides of large flat-bottomed valleys running into the upland country, low broad benches about 50 feet high can frequently be seen carved out of the solid rock.

4. Finally there occur also, particularly in the Colony (I, p. 116), small platforms varying in height from 35 to 325 feet.†

* See Papers VI, VII, and VIII, for the economic uses of these clays.

† Cf. the marine terraces of the Gold Coast, A. E. Kitson, *op. cit.*, p. 370.

The relations existing between these various platforms have been established in many localities; in some places the platforms may be seen in actual juxtaposition in a horizontal sense but connected vertically by a steep scarp, whereas in others they are linked up by a relatively narrow tract of hilly country or by a zone of greatly increased gradient. For instance, in northern Pendembu district the 700-foot platform passes up into the great plateau through an area of hilly country, the hills being flat-topped and corresponding in height to the upper level; the same platform near Malema, 30 miles to the south, passes down into the 400-foot platform through an irregularly hilly zone, the foot of the hills generally corresponding to the level of the lower platform.

In north-eastern Karina District, the 700-foot platform is separated from the Koinadugu plateau by a fairly well-defined scarp, along a great part of which the Kabba river flows; it passes down into the lower platforms east of Yatea through the medium of a number of flat-topped hills and ridges. In the neighbourhood of Mabonto, in south-western Koinadugu District, the 700-foot platform is represented by a remarkable series of parallel discontinuous ridges that rise out of the 400-foot platform near its junction with the worn scarp of the Koinadugu plateau. Finally, it is interesting to note that the railway main line runs over the 400-foot platform as far as Kennema, where it commences to ascend on to the 700-foot platform, on which it continues as far as the terminus at Pendembu. Scarps separating the 400, 450, and 525-foot platforms may be found without difficulty near Kotohun along the southern edge of the Lokko mountains, and about the foot of many of the larger hills south of Moyamba.

It is of interest to note how the form and disposition of the hills rising out of the coastal plain are related both to the underlying solid rocks and to the sediments of the plain. Hills representing the younger platforms generally consist of a layer of sediments resting upon a more or less even surface of the solid rocks; in extreme cases they consist only of the solid rock or appear to be made up only of sediments.

Very frequently a close relation exists between the alignment of the hills, either as individuals, groups, or chains, and the dominant strike of the solid rocks out of which they have been carved. For instance, the parallel ridges near Mabonto, referred to above, individually follow the north-north-easterly strike of the constituent granitic rocks; similarly the Bonge hills, the Imperri and Gbangbama hills, the Moyamba hills, and many others, all running in a north-north-westerly direction, are aligned parallel to the foliation of the ancient crystalline rocks that compose them. The sedimentary rocks of the central and north-western part of the plain have rarely, if ever, proved sufficiently resistant to form hills, but the hard volcanic rocks associated with these sediments have given rise, along their strike, to a chain of hills that can be traced across the country for nearly 100 miles before reaching the Anglo-French

boundary. Amongst these hills may be mentioned those south-west and north-east of Yonnibana, the Malal hills, the low hills around Wongkufu, and others beyond Kukuna near the Great Scarcies river. The hills due to the volcanic rocks and ashes are generally very rugged, and encumbered with innumerable rocky crags; even where these rocks do not form hills, they often cause the surface of the plain to be broken by a large number of low rocky mounds which are in strong contrast with the smooth, gently convex granite hummocks.

Faulting does not appear to have been responsible for any of these hills or ridges.

Owing to the intermittent character of the uplift that produced the coastal plain, the variable nature of the rocks underlying the plain, and the variable strength of the rivers themselves, the rivers flowing across the plain show different stages of maturity and rejuvenation both within themselves and as compared one with the other. Most of the rivers had reached grade level for a longer or shorter time prior to the later uplifts, and consequently they now show many striking phases of rejuvenation. Partly on this account, and partly because they run directly across the strike of the solid rocks underlying the plain, the Taia river and the other larger rivers to the north-west all offer remarkable contrasts in the development of their upper, middle, and lower courses. For the present purpose the upper course may be considered as that part of the river flowing across the older crystalline plateau, the middle course as that part flowing over the old sedimentary rocks underlying the plain, and the lower course as the portion that crosses the hard volcanic rocks and the belt of ancient crystalline rocks near the coast. The greater part of the upper courses of the rivers are doubtless of great antiquity, as will be seen below, but they nevertheless show evidence of progressive uplift over a long period; they are naturally less likely to show the effects of individual uplifts than the lower and middle courses; but in spite of this the upper courses are in general broken by many rapids.

The middle courses, owing to the low resistance of the rocks they traverse, had not only reached local grade-level prior to the latest uplifts, but had also cut out extensive flood plains. These old flood plains now stand well above the modern flood plains; they are generally well covered with vegetation and they support many villages. Excellent examples of such flood plains may be seen on the Great Skarsies river below its confluence with the Kora river, and on the Mabole river at Baibanna, some miles above Batkana. Subsequent uplift, however, again imposed conditions of rejuvenation upon the middle courses of the rivers and they began to cut down to a lower level; but the rocks of the lower courses proved so resistant that the rivers in their middle courses soon cut down to the local grade level and then commenced to cut laterally. A glance at the map shows that the rivers, particularly the Rokell and the Great Skarsies, have cut a wonderfully complex series of meanders in their

middle courses, which are thus in strong contrast with the upper and lower courses. These meanders are continuously increasing in range, and at every bend the rivers can be seen to be vigorously undercutting their banks; these banks readily yield to the activity of the rivers, since they generally consist only of soft shales and sandstones overlain by superficial deposits.

The lower courses of the rivers, where they flow over the belt of ancient metamorphic rocks, show ample evidence of rejuvenation: for instance, above tidal limits there is an almost continuous series of rapids and steep cascades, together with an occasional waterfall, and also, as has already been mentioned in an earlier paragraph, there exists near the mouth of nearly every river a low waterfall only a few feet high. Before the most recent uplift, however, the rivers had been able to produce small flood plains locally, since alluvial flats may sometimes be seen slightly above modern flood level; similar flats are recorded by Parkinson from south-western Liberia.* Finally, the rivers have developed incised meanders in several localities, and they have, moreover, cut deep gorges into the sediments of the plain and into the underlying crystalline rocks.

From the foregoing it is clear that the rivers flowing across at least the greater part of the coastal plain form a superimposed drainage system; this is seen from the way in which the rivers strike boldly across the broad outcrops of softer and harder rocks, and also from their behaviour towards certain of the smaller features they encounter.

The rivers generally follow a very winding and complex course in their lower or tidal portions across the low-lying coastal belt, which is intersected by countless creeks. These tidal portions extend upwards from the sea for a distance of 25 to 30 or even 40 miles; like the neighbouring tidal creeks they are lined by a broad fringe of mangrove swamp.

It should be noted, however, that many of the rivers, shortly before entering upon the area of tidal creeks, flow through narrow steep-sided valleys in which the older crystalline rocks are well exposed.

The southern and south-eastern portion of the plain falls within the coastal belt of West African tropical forest, whereas the northern part extends into the zone of savannah grassland, or steppe. Very little of the original forest remains, however, because within recent years enormous areas of it have been destroyed by primitive but wasteful methods of farming.

The forest so destroyed has been replaced by low scrubby bush, and this, after repeated cutting and burning, by grass and orchard bush of savannah type. Over the central and northern parts of the plain it is thus often impossible to say whether the grassland now existent is original or not. The only remaining forest of any considerable size that is still to be found on the plain is that known as the Gola forest, which covers an extensive area along the Liberian Frontier; this forest has recently been

* A. E. Kitson, *op. cit.*, p. 316.

found to be the home of large anthropoid apes, as well as of elephants and hippopotami. Almost the whole of the country along and south of the railway is now covered with scrubby bush that has grown up in place of the original forest. Here and there are large patches of grass, sometimes as much as several miles in extent. The oil-palm, which flourishes over the central and southern parts of the plain, as well as on the lower crystalline plateaux, appears to be completely replaced by the fan-palm over a large area to the north and north-west of Batkana.

3. The Peninsula.

The Colony is sharply distinguished from the Protectorate both in its geographical and its geological characters; it takes the form of a mountainous peninsula which rises abruptly from the seaward margin of the low-lying coastal plain of the Protectorate, and it consists of an interesting noritic (gabbroidal) complex which was intruded in the form of a huge stock (V). Its mountains rise steeply from a narrow coastal plain, continuous with that of the Protectorate, to a height of nearly 3000 feet.

In the course of erosion a number of platforms have been carved into the mountain mass. The more important of these platforms attain maximum altitudes of about 2400 feet, 1800 feet, and 1300 feet respectively; they can all be distinguished without difficulty from the summit of one of the higher peaks of the northern end of the Colony, and also from the sea a few miles west of Freetown harbour. The highest platform can be seen at a level slightly below the summit of Sugar Loaf Mountain, the second slightly below that of Leicester Peak, while the third forms the high ground that encloses Freetown on the south-east, south, and south-west. The oldest platform forms the upper limit of the broad middle ridge that traverses the Colony from end to end. Out of the north-western end of this platform Sugar Loaf Mountain rises to a height of 2494 feet above sea-level, and out of the south-eastern end rises a group of peaks, most of which are about 2700 feet in height; Picket hill, probably the highest of these peaks, attains an elevation of 2912 feet. The second platform is recognized principally in the even tops of the two side ridges that run parallel with the main ridge of the Colony, whereas the third can be traced at intervals around the flanks of the higher platforms. This third platform is particularly well developed in the Freetown area, where it forms, for instance, the Havelock and Gloucester plateaux, extending for nearly 3 miles south of Mount Aureol, and also the ridge running more or less south-eastwards from Hill Station towards Leicester Peak. Several smaller platforms can be recognized at intermediate and at lower levels; those at the lower levels correspond in height to low flat-topped hills and ridges that occur in neighbouring parts of the Protectorate, such as the Malal hills, the hills south of Moyamba, and those a short distance north-west and north-east of Makump.

The stock possesses a deeply incised drainage system, remarkable for its regularity and simplicity, which has apparently developed as a result of erosion along the master-joints; these joints are parallel and transverse to the length of the stock in the middle portion and radial at the ends.

The natural scenery of the Colony is remarkably beautiful. The mountains, rising rapidly to a height of nearly 3000 feet at the southern end of the peninsula, present a bold relief which is equalled in the Protectorate only by such masses as the great mountains of northern Konno. The mountains of the Colony, however, are very different in appearance from most of the higher mountains of the Protectorate; consisting wholly of norite, they show the scarred, rugged outlines common to great masses of basic rocks, whereas the mountains of the Protectorate, consisting of granite, frequently weather into great, smooth, symmetrical domes. Again, the mountains of the peninsula, constituting an important forest reserve, are all clothed in fine forest bush, whereas those of the Protectorate, especially in the more northern parts of the country, are frequently quite bare, apart from a few small tufts of grass.

Freetown possesses the finest as well as the most beautiful natural harbour along the whole of the West Coast. Nevertheless, although a safe and deep anchorage extends to within a very short distance of the shore, large ships are still unable to load and unload their cargoes except by means of lighters and barges; unfortunately, a comprehensive scheme for improving the shipping facilities of the harbour had to be abandoned on the outbreak of the European War. The harbour rests under the shelter of the mountains that form the northern end of the peninsula, but it is separated from these mountains by the narrow strip of coastal plain upon which Freetown stands. The town is half encircled by an irregular scarp which rises abruptly from the coastal plain to a height of about 700 feet; from the top of the scarp the country slopes gradually upwards to the foot of Leicester Peak and Sugar Loaf, the two imposing peaks, rising respectively to heights of 1952 and 2492 feet, which play such a prominent part in the majestic scenery observed from the harbour. Magnificent views may be obtained from these peaks on a clear day: all around and far to the south-south-east extends the rugged mountain mass that makes up the peninsula; inland and along the coast, almost as far as the eye can see, stretches the great low-lying coastal plain, dotted with many hills; northwards, in the direction of Freetown and the harbour, and in the dim distance beyond the Bullom shore, rise the great mountains of French Guinea. These mountains, made up of a great series of almost horizontal sandstones resting upon ancient crystalline rocks, appear in profile to consist of several great blocks tilted slightly in different directions. A little to the west of them there are several smaller masses of rounded form; these are the Los Islands, situated opposite Konakri, at a distance of nearly 100 miles from Freetown.

The structure and the surface features of the narrow coastal plain that runs around the foot of the mountains of the peninsula are essentially similar to those of the great plain of the Protectorate, which have already been described.

4. The Upland Area.

For convenience of description the plateaux constituting the upland area may be regarded as belonging to an upper and a lower series; nevertheless, as between the lower series and the higher platforms of the coastal plain, so also between the two upland series, nothing in the nature of a wide break can be observed.

The lower series consists of several plateaux which do not differ very much in height; since these plateaux cover the whole of Koinadugu District and a large part of Konno District, it will sometimes be convenient to refer to them collectively as the "Koinadugu plateau." The altitude of the greater part of this plateau ranges from about 1400 to 1700 feet above sea-level. The upper series, consisting of a number of isolated complex platforms which stand up out of the lower series, occupy a relatively small area.

Outlying portions of the lower series of plateaux exist as the Lokko mountains, Makene hill, the Moyamba hills, and Kissi country; moreover, it is possible that the basement of granitic and sedimentary rocks, upon which rest the horizontal sandstones of the Saionia scarp, also forms part of the same series of plateaux. The western and southern margins of the main Koinadugu plateau run approximately as follows: from near Sirekuri to Kamabai and to a point a few miles east of Makump; thence it turns south-east, and, passing some miles north of Mongeri, gradually approaches the railway and runs eastward parallel with it but a few miles to the north. On the western side of the plateau, north of Makump, the plateau edge is well defined, although indented by deep bays and long narrow inlets; around and north of Kamabai it generally rises about 800 feet above the inner margin of the coastal plain, and it sometimes takes the form of a bold inland cliff. On the south-western and southern margins of the plateau, on the other hand, it is often only very vaguely defined.

Many low scarps and plateaux, carved into the crystalline rocks, can be seen rising above the main plateau in various parts: for instance, at Kurubunro, on the eastern side of the Loma mountains, there are several flat-topped hills rising about 200 feet above the general level of the country,* and west of Kafogo, on the Kaballa–Kamabai road, there is a plain several miles wide overlooked on the western side by the worn edge of a low plateau about 150 feet high, which is in turn, further west, surmounted by another rising some 250 feet higher. Moreover, in several places such low plateaux, as they are followed outwards towards their

* Falconer has described similar features from Northern Nigeria; *op. cit.*, p. 44.

THE SEWA RIVER NEAR BAOMA

TYPICAL PLATEAU COUNTRY WEST OF KABALLA

MOUNTAIN NEAR KAMABAI

KAMABAI MOUNTAINS : SLAB OF GRANITE ON POINT OF BREAKING AWAY

margins, are seen to be intersected by broad, flat-bottomed valleys with steep rocky sides, which cut down to the level of the adjacent main plateau; nearer the margins, these plateaux become penetrated by numerous small inlets, after which they become broken up into a fringe of low hills with flat tops and rocky sides. These conditions, which are exemplified in the country around the Maufi valley in eastern Konno, are similar to those met with along the inner margin of the coastal plain, as, for instance, near the valley of the Kabba River in north-eastern Karina District (above, p. 47); they strongly suggest that marine erosion has played at least some part in the present configuration of the Koinadugu plateau.

The following plateaux have been recognized as belonging to the upper series of crystalline plateaux; actually, they form a continuous series with the lower plateaux, as already stated in an earlier paragraph. They occupy only a small area as compared with the lower series.

1. *Plateaux of North-Eastern Konno and adjacent parts of Koinadugu District.*—This area, extending northwards from Kainkordu to the country around the source of the Niger, forms a plateau * ranging from 2200 to 2600 feet in height: the Niger † rises as a tiny stream in a little valley on this ancient plateau. A few miles south of the Niger source a second plateau rises out of the first plateau to a height of 2800 to 3200 feet; it slopes gently towards the east and possesses a well-defined western scarp. This plateau, which measures about 8 miles from west to east, is locally overlain by sheets of basalt. A few miles further south there is the great mountain mass of north-eastern Konno. Some of the mountains of this area take the form of enormous towering pinnacles, of extraordinary aspect, which rise several thousand feet above the surrounding plateau; they probably attain a height of fully 5000 feet above sea-level. The broad flat tops of several of the mountains indicate the presence of an ancient plateau.

2. *Plateaux of the Loma Mountains.*—The Loma mountains form an irregularly shaped mass about 15 miles in diameter; this mass, rising boldly out of the Koinadugu plateau, which in this area stands at about 1600 feet above sea-level, takes the form of a succession of crystalline plateaux. The main plateau, which rises to an altitude of nearly 5000 feet, supports several more or less conical peaks. Bintumane, the tallest of these peaks and also the highest mountain of the Protectorate, towers more than 1000 feet above the main plateau (VIII, p. 5). A remarkable feature of this mountain is that it is

* The physiographical and geological characters of this plateau, particularly in the country around the source of the Niger, are remarkably like those of the Bauchi plateau in Northern Nigeria, described by Dr. J. D. Falconer (*op. cit.*, pp. 3 and 42). The main features of the landscape are due to the floor of ancient crystalline rocks, whereas the minor features are due to a thick superficial accumulation of sand and rock débris. See VIII, p. 4.

† It is a remarkable fact that the Niger, a river 2600 miles in length and the third longest river in Africa, should rise at such a low altitude and at a distance of no more than 160 miles from the sea; in addition to this, it falls to 1000 feet above sea-level within the first 250 miles. The Nile and the Congo, the only two rivers in Africa of greater length, both rise far inland at an altitude of 7000 feet.

capped by a sheet of coarse dolerite, which is 250 feet thick and about 400 yards in length ;* this flat summit is the only remaining portion of the oldest plateau of the Sierra Leone Protectorate. It attains a greater height than any of the mountains of Fouta Djallon,† and is equalled in this part of West Africa only by the great mountains of eastern Liberia, one of which is believed by certain French travellers to rise more than 9000 feet above sea-level.‡ For several miles along the northern side of the Loma mountains there runs a well-defined platform which attains a height of about 2600 feet and locally exceeds a mile in width.

3. *Plateaux of the Wara Wara Mountains*, north of Kaballa. These plateaux, which are of small size as compared with the others just described, are characterized by bold scarps. In particular, two plateaux can be distinguished without difficulty ; rising high above the Koinadugu plateau, they attain heights above sea-level of about 1800 and 2400 feet respectively.

To the plateau described in the preceding paragraphs may be added the Saionia plateau (2200 feet), which, however, differs from the others in that it is essentially a plateau of horizontal sandstones overlain by a sheet of coarse dolerite ; these sandstones, nevertheless, rest upon an ancient surface of crystalline rocks. The Saionia plateau covers a large area in French Guinea, north-west of Sierra Leone, and the Anglo-French boundary north of Saionia runs for several miles along the southern scarp of this plateau.

The plateaux have suffered various degrees of erosion according to their age and the nature of the constituent rocks. The oldest plateau of all, that forming the summit of Bintumane, owes its preservation entirely to the overlying cap of dolerite, and large portions of the 3000-foot plateau south of the source of the Niger have been similarly preserved. The lower plateaux of the Loma Mountains and the Wara Wara plateaux have all suffered extensive erosion, and although parts of them are even now in a wonderful state of preservation, yet on the whole their surfaces are strongly corrugated. The ancient plateau of northern Konno, which at one time probably formed part of the 5000-foot plateau of the Loma Mountains, is now represented by numerous towering peaks and mountains, some of which possess summits that are still remarkably flat.

The plateau-form of these ancient massifs can easily be recognized from a distance, and also, in most cases, even in the course of a journey

* It is worth recording that on the northern side of the peak, in a small cavern eroded in the débris accumulated at the foot of the dolerite scarp, there was seen a mass of luxuriant vegetation which was in sharp contrast with the short, dried-up, tufted grass growing all around. It was, moreover, a matter of great surprise to see a solitary tree-fern rising up amidst this foliage and reaching the narrow opening in the roof of the little cavern. Tree-ferns are rare in Sierra Leone, being known only at the source of the Niger, at Kundukonko, and at one or two other localities. The specimen referred to has been kindly determined by the Director of the Royal Botanic Gardens, Kew, as *Cyathea manniana*, Hook. ; it existed at a height of 5800 feet, *i.e.* much higher than any tree-ferns seen elsewhere in Sierra Leone.

† See J. Chautard, 'Étude Géophysique et Géologique sur Fouta Djallon,' Paris, 1905. Name spelled Futa Jallon on map, R.G.S. II. system.

‡ Sir H. Johnston, 'The Republic of Liberia,' 1906 ; also Delafosse, "Le Liberia en 1907," *Bull. Comm. Afrique Française*, 1907, No. 12, p. 345.

across them. Sometimes, however, they have suffered so much erosion that they appear to form, when viewed at close quarters, only a large tract of irregularly hilly or mountainous country. Such a tract extends around and south of Magboloko, in southern Koinadugu District; this area is particularly rough and rocky, and it is consequently very trying country to travel over.

The scarps of the various plateaux show very great variety in their state of preservation; some of them are still bold and rocky, following sinuous and indented courses, while others are so worn that they exist only as tracts of hilly country intervening between two plateaux of different height. No evidence has been seen in the field to indicate that any of these scarps, with the possible exception of Saionia, is in any way due to faulting.

The following are important examples of the scarps:

1. The Saionia scarp, 1600 feet in height at the western end. This scarp which extends north-eastwards into French Guinea, is almost vertical in the upper half, owing to a thick development of horizontal sandstones which are capped by a sheet of dolerite.

2. The scarp separating the great plateau from the coastal plain, east of the Kabba river, in north-western Koinadugu District; about 800 feet in height.

3. The margin of the Loma Mountains is sufficiently abrupt in many places to be termed a scarp; indeed, on the northern side of the mass the scarp separating the 2700-foot from the 1600-foot plateau is highly precipitous over many miles of its length. As the Bassikanda stream descends this scarp near the foot of Bintumane it forms a beautiful slender waterfall of great height.

4. The scarp of the 2000-foot platform of north-eastern Konno, which runs eastwards from Kainkordu towards Koardu and then northwards towards the source of the Niger, is well defined; it rises 800 to 1000 feet above the country to the south and east. The Meli river, which in this part of its course forms the Anglo-French boundary, runs along the foot of the eastern scarp; its western tributaries, such as the Wee, the Mum, and the Moni, have carved deep valleys into the plateau, so that the present state of the scarp recalls that of the eastern margin of the North Wales mountain mass where it is trenched by the valley of the Dee and other rivers. East of the Meli River, in the area considered, there extends a great plain at an altitude of about 1000 feet, broken only by one or two such masses as Konosso Peak, which attains an altitude of more than 4000 feet.

5. The western scarp of the 3000-foot plateau south of the source of the Niger forms an imposing feature, as it rises 1700 feet above the lower plateau that extends westwards to the foot of the Loma Mountains. Seen from a distance, the top of this scarp is in places remarkably level, owing to the presence of several residual patches of a once-extensive sheet of dolerite.

The Sewa River, as it descends to the coastal plain over the much-worn southern edge of Koinadugu plateau, gives rise to the magnificent waterfall known as the Sewa or Pundaru Falls. In the dry season the falls, which are about 85 feet wide, attain a height of 90 feet, but in the rainy season, owing to the banking up of the water in the narrow gorge immediately above, they are probably well over 100 feet in height. For a considerable distance above and below the falls the river traverses a long series of rapids and steep cascades. Some years ago the falls attracted much attention in Sierra Leone

because of a suggestion that they could be employed in the electrification of the railway.

The following are the more important features observable in the erosion of the plateaux themselves:

Rising here and there above the surfaces of the different plateaux, especially near the scarp of a higher plateau, there are certain residual mountains, or inselbergs, characterized by a dome-like upper surface and steep precipitous flanks. These mountains, which are often devoid of vegetation apart from a few tufts of grass, vary in height from several hundred feet to 1500 feet or more (VI, p. 6).

Again, the surfaces of the plateaux are sometimes surprisingly flat over considerable distances, and in such cases they are either thinly covered by lateritic gravel, supporting a sparse orchard bush, or they are quite bare. Such areas, which occur for instance on the Koinadugu plateau west of Kaballa and in Kissi country around Dambarra, are often sharply trenched by deep V-valleys to a depth of 200 or 300 feet. Many of the plateaux have been seen to possess a gentle slope towards the east or south-east which is doubtless original in many cases; nevertheless, there is reason to suppose (see below, p 61) that the eastward slope of certain of the plateaux has been produced or accentuated by a slight regional tilt in that direction.

The flatter parts of the plateau surfaces sometimes give rise to extensive swamps. Only one lake is known, however, and this, for a large part of the year at least, is little better than a great swamp: Lake Sonfon, as it is called, is situated in an area of very low relief, 25 miles south of Kaballa, at an elevation of about 1800 feet.

In some places the surfaces of the plateaux are characterized by many broad low hummocks, possessing smooth rounded contours, which rise 100 to 150 feet above the general level. In the western part of Koinadugu District the hummocks sometimes assume the form of flat-topped ridges separated by low flat-bottomed swampy depressions. An extensive series of low parallel ridges near Kamabanzi was found to run parallel with the jointing of the granite.

A distinct type of topography that deserves special mention is that developed, for instance, in south-eastern Koinadugu District between Kulia and the Loma Mountains, and in the wide valley of the Seli River south of Kaballa. It consists of innumerable low rocky hills, like small tors or kopjies, ranging up to 150 feet in height; these hills are scattered irregularly over the surface of the plateau and are sometimes so numerous as to be more or less in contact. A form of landscape almost identical with this has been described by Dr. J. D. Falconer,* from parts of Northern Nigeria.

Finally, some parts of the country, as in the area north of Tungea for

* 'The Geology and Geography of Northern Nigeria,' 1911, p. 59.

instance, have been carved into an irregular series of sharp ridges and valleys; the ridges rise 150 to 200 feet above the floor of the valleys, which are almost invariably swampy.

At Fanama in northern Konno is an interesting relic of a former period when erosive agencies were probably much more active than they are at present. It takes the form of large caverns or "caves" which occur as interstices amongst certain huge more or less round masses of granite that fill part of a small valley incised into the plateau. These masses are piled up one above the other upon an inclined surface of basalt which extends along the bottom of the valley. One of them, more than 50 feet in diameter and about 25 feet thick, rests in a horizontal position partly upon the basalt and partly upon a few smaller masses of granite; it is in turn overlain by several other huge masses. The most probable explanation of the phenomenon appears to be as follows: At some distant time a flow of basalt made its way along the floor of an ancient valley carved into the plateau; in the course of erosion and denudation of this plateau, one or both sides of the valley collapsed upon the basalt floor; then, as the finer débris was slowly removed from amongst the larger masses, a series of irregular interconnected caverns, forming the present "caves," gradually appeared. Formerly, in times of tribal war, these caverns afforded valuable shelter to some of the Koranko people, more especially as the stream that still flows along the bottom of the valley, beneath the great granite masses, yielded a good supply of water.

Interesting relics of ancient valleys and drainage systems may be seen at different places on the various plateaux. These features often bear little if any relation to the drainage of the present day, largely owing to the widely different ages of some of the plateaux and also to the extensive erosion that most of the plateaux have undergone. Moreover, there is evidence to show that some changes have been brought about by gentle regional tilting (see below, p. 61).

The ancient valleys are often broad, flat-bottomed and steep-sided; their crystalline floors are flat or in some cases hummocky (VII, p. 3). The town of Dunkawalia in Koinadugu District is situated in a valley of this type; this valley is half a mile wide, and its sides are 200 to 250 feet high. These ancient valleys are generally occupied by streams which are proportionally very small,* whereas certain of the larger modern rivers flow for parts of their courses in gorges or narrow valleys. Certain other steep-sided valleys are very deep; the valley of the Njanga River, in the north-western part of the Koinadugu District, has been excavated to a depth of fully 700 feet. In one part of this valley pebble-beds occur at a height of 70 feet above the present level of the river, doubtless a result of late rejuvenation.

* Very similar conditions occur in Northern Nigeria: see Falconer, *op. cit.*, p. 3; see also VIII, p. 4, *re* Mantili valley in south-eastern Koinadugu District.

It is interesting to note that the cap of coarse dolerite forming the summit of Bintumane is traversed from west to east by the remnant of a little valley; at either end this valley terminates abruptly in mid-air, an effect due to extensive erosion of the ancient uplifted dolerite plateau.

The Fanama caves (see above, p. 57) mark the site of an ancient valley that has now completely disappeared.

5. Origin of the Plateaux and Scarps.

The evidence so far collected points strongly towards a marine origin for the lower plateaux and scarps described in the preceding paragraphs. Moreover, it appears probable that the high plateaux also originated in this manner, although the evidence in the case of these is less conclusive. It may be pointed out, however, that Bintumane, a remnant of the 6000-foot plateau (see above, p. 53) rises as a steep, more or less conical peak out of the 5000-foot plateau of the Loma Mountains, and also that this 6000-foot plateau, as well as the 3000-foot plateau of south-eastern Koinadugu District, is capped by a sheet of dolerite which rests directly upon granite showing very little alteration.

It is evident that the various lower plateaux are themselves of widely different ages: the plain of erosion upon which the Saionia Scarp sandstones rest, which is probably represented amongst the plateaux further east and amongst those of the Colony, is doubtless of marine origin; it stands at an elevation of about 1000 feet, and probably dates from early Palæozoic times.* On the other hand, many other plateaux, not differing greatly from this one in altitude, are apparently much younger; the evidence available indicates that they were formed in the course of intermittent uplifts, complicated by occasional subsidences.

The principal reason for regarding the lower plateaux at least as marine in origin rests mainly in the fact that a close analogy may be observed between the relations which the various platforms of the coastal plain bear to each other, and the relations one to another of the lower plateaux of the upland areas. Moreover, as has already been mentioned (p. 52, above), the distinction between the upper platforms of the coastal plain and the lower plateaux of the upland area is largely an arbitrary one. The analogy between the coastal plain and the lower plateaux is seen mainly in the presence in each of deeply embayed scarps, the larger indentations of which pass upwards into ancient valleys, in the presence of flat-topped "islands" that attain to the level of the adjacent plateaux, and in the manner in which the lower plateaux more or less completely encircle the upper.† Finally, the disposition of the plateau sands with regard to the crystalline plateaux is in many respects similar to the

* Graptolites have been found a few miles away in the horizontal sandstones of French Guinea, which are apparently continuous with the Saionia Scarp sandstones. See H. Hubert, 'État Actuel de nos Connaissances sur la Géologie de l'Afrique Occidentale,' Paris, 1919, p. 7.

† This feature is particularly well displayed amongst the high plateaux of the Colony.

disposition of the sediments of the coastal plain with regard to the crystalline platforms. It is conceivable that some fault scarps exist in the area considered, but, with the possible exception of part of the Saionia scarp, they have not been recognized as such, and they are consequently believed to be of relatively little importance. It should nevertheless be mentioned that fault scarps of late geological age are known to occur amongst the plateaux of Fouta Djallon,* the Gold Coast, † and Northern Nigeria. ‡

6. The Age and Origin of the Plateau Sands.

The Plateau Sands extend over the whole of the central and north-eastern parts of the Koinadugu plateau, and range in altitude from 1000 feet above sea-level to 5000 or even 6000 feet; they consist of fine dusty sand mixed with a variable proportion of angular and sub-angular quartz-grains, and often contain large and small angular fragments of quartz and of kaolinized granite. The Sands generally rest upon smooth and comparatively unweathered surfaces of rock, while the upper surface of the Sands frequently takes the form of terraces surmounted by a ferruginous cap. A more complete account of these deposits as they are seen in the field has already been given elsewhere (VIII), and consequently in the present discussion attention will be directed mainly towards the question of their age and origin. Similar deposits appear to exist on the plateaux of neighbouring parts of French Guinea and in Fouta Djallon, § and flat-topped hills of sand are recorded also from the plateaux of the Gold Coast. ‖ Moreover, while deposits of similar type have been described from Southern Nigeria under the name of "Benin Sands," ¶ the most closely analogous formation appears to be the "drift" of Northern Nigeria, of which Dr. J. D. Falconer has given a very detailed account.** The "Benin Sands," the drift, and similar deposits in adjacent countries are believed to be of late Tertiary age; moreover, while the deposits themselves were formed during movements of very pronounced subsidence, many of the prominent features in the physiography of the areas referred to are due to the succeeding movements of elevation.†† By analogy with these deposits it is reasonable to conclude that the Plateau Sands of Sierra Leone are also of late Tertiary age,‡‡ and further that

* J. Chautard, *op. cit.*

† A. E. Kitson, "The Gold Coast," *Geog. Journ.*, 1916.

‡ J. D. Falconer, *op. cit.*, p. 45.

§ J. Chautard, 'Étude Géophysique et Géologique sur Fouta Djallon,' Paris, 1905.

‖ A. E. Kitson, Rep. Geol. Sum. Gold Coast, 1919.

¶ J. Parkinson, *Q.J.G.S.*, 63. 1907, p. 399.

** J. Parkinson, 'The Geology and Geography of Northern Nigeria,' 1911, p. 197.

†† J. D. Falconer, *op. cit.*

‡‡ The suggestion as to the late Tertiary age of these beds is not necessarily affected by the fact that the deposits are still unconsolidated, since uncompacted Pliocene beds bearing marine fossils are well known to occur at considerable altitudes in various parts of the world. See Chamberlin and Salisbury, 'Geology,' London, 1906, p. 314.

these Sands, in common with the other deposits considered, originated during a period or periods of great depression, when processes of decay and accumulation were at a maximum. Furthermore, the present configuration and disposition of the Sands have doubtless been determined essentially by a series of intermittent uplifts, which followed closely upon the period of accumulation. The terraces which form such a striking feature of the Sands may be regarded, like the analogous terraces cut into the deposits of the coastal plain, as having been carved out during the intervals between successive uplifts. In many places the terraces have been greatly modified by later subaerial erosion.

It would be difficult to account for the field characters of the Sands and their relation to the crystalline plateaux on any hypothesis other than that outlined above. In all cases examined the terraces appear clearly to be due to erosion and not to faulting, and the fact that the Sands rest upon a succession of crystalline plateaux which often occur as upstanding masses and as benches of no great width, practically cuts out the possibility of the terraces being due to some terrestrial agency. Evidence has already been adduced to show that scarps of most, if not all, the crystalline plateaux and benches referred to are due essentially to erosion, probably marine (see above, p. 158).

The great uplifts of late Tertiary and Quaternary ages postulated for the plateaux areas of Sierra Leone are closely paralleled in those already known to have occurred elsewhere in West Africa,* as well as in Western Europe,† and in Western America.‡

It is difficult to say how far the ancient crystalline plateaux were modified by the late Tertiary uplift. Certainly the more important plateaux and many of the deep valleys carved into them were already in existence; this is evident from the fact that the Plateaux Sands at one time completely filled even the largest valleys incised into the plateaux (VIII, p. 4), and that they may yet be seen banked up against some of the ancient scarps. There is ample evidence to show that the Plateau Sands profoundly modified the ancient drainage systems of the plateaux § just as

* The Bauchi Plateau (4100 feet) is considered by Dr. J. D. Falconer to have been uplifted from sea-level since early Pliocene times (*Ibid.*, *op. cit. supra*, p. 230).

† For Pliocene and later uplifts of great magnitude along the north-eastern shores of the Atlantic, see W. H. Huddlestone, "La Bordure Orientale de la partie septentrionale du bassin de l'Atlantique," and Edward Hull, "Anciennes Vallées envahies par la Mer et à divers autres traits physiques des Îles Britanniques et de l'ouest de l'Europa," both in *Congr. Geol. Inter. C.R.*, 8, 1900, Pt. I., pp. 319 and 321 respectively. See also G. Barrow on "The High-Level Platforms of Bodmin Moor," *Q.J.G.S.*, 1908, p. 384.

‡ An elevation of 6000 feet is considered to have taken place since Pliocene times in Western Colorado; see 'The Tertiary History of the Grand Cañon,' U.S. Geolg. Surv., Monograph II., 1882. See also Chamberlin and Salisbury, *op. cit. supra*.

§ The behaviour of the Seli river east of Makump is probably an instance of this. South of Kaballa the river winds through a broad shallow basin encumbered with numerous hills of sand and rock débris; some miles lower down, shortly before coming upon the inner margin of the coastal plain, the river escapes from the basin by means of a deep gorge excavated through both the superficial deposits and the underlying granite.

WARA WARA MOUNTAINS NORTH OF KABALLA· EASTERN SCARP OF PLATEAU

THE COASTAL PLAIN FROM SCARP OF THE KOINDAGU PLATEAU

SOURCE OF THE NIGER IN SMALL VALLEY OF LEFT MIDDLE DISTANCE

THE MOUNTAINS OF NORTH-EASTERN KONNO, LOOKING SOUTH-WEST FROM DURUKORO

the "drift" of Northern Nigeria modified the pre-existing drainage systems of that country.* Moreover, it will be obvious from the descriptions already given that the modern scenery of the upland areas is greatly influenced by the presence of the Plateau Sands; in many localities the irregularities of the ancient crystalline landscape are either hidden from view or softened in outline, while in others the uneven erosion of the Sands has given rise to numerous low rounded and flat-topped hills which lie freely scattered over the various crystalline platforms (VII, p. 2). These superficial accumulations, where unencumbered by a crust of ferruginous conglomerate ("laterite"), give rise to large areas of fertile land, much as they do in Fouta Djallon.†

An interesting case of diverted drainage of uncertain but probably late age has been observed in the northern part of the Protectorate. It will be seen from the map that nearly all the rivers of this part of the country flow westwards for a time and then take a sharp turn towards the south. The most obvious explanation of this phenomenon is that the area considered gradually became tilted towards the east; as a result of this movement the gradient to the west gradually diminished until it became less than that to the south; this caused the rivers to abandon their westerly courses and gradually to assume a more southerly direction. Several cases of river-capture exist as an additional result of the easterly tilt; moreover, as already mentioned in an earlier paragraph, several of the crystalline plateaux possess a marked slope towards the east.

In conclusion, I have much pleasure in acknowledging the assistance and the many kindnesses I have received from numerous officials in the Government Service in the course of my work in Sierra Leone.

7. Appendix.

The following publications on Sierra Leone, by F. Dixey, have been referred to in the course of the present paper:

I. "Pleistocene Movements in Sierra Leone," *Proc. Geol. Soc. S. Africa*, 1919, p. 112.
II. "Lateritization in Sierra Leone," *Geol. Mag.*, 1920, p. 211.
III. "Physiographic Relations of Laterite," *Geol. Mag.*, 1920, p. 524.
IV. "Primitive Iron-Ore Smelting Methods in West Africa," *Min. Mag.*, October, 1920.
V. "The Norite of Sierra Leone," *Proc. Geol. Soc.*, 1921, p. 103.
VI. Report of the Geological Survey of Sierra Leone, 1919.
VII. Report of the Geological Survey of Sierra Leone, 1920.
VIII. Report of the Geological Survey of Sierra Leone, 1921.

Before the paper the PRESIDENT said: I have much pleasure in introducing to you Mr. Dixey, who has made a three years' reconnaissance of the geology of Sierra Leone, and is now on his way out to Nyasaland.

* J. D. Falconer, *op. cit.*, p. 241.
† J. Chautard, *op. cit.*

Mr. Dixey then read the paper printed above, and a discussion followed.

Mr. R. W. H. WILKINSON (Governor of Sierra Leone): Mr. Dixey in his lecture told you, as is usual on such occasions, a great deal about his subject and very little about his own experience, and perhaps I may be excused if I am a little more personal. I went to Sierra Leone about two years before Mr. Dixey came there, and two things impressed me most forcibly. The first was the utter lack of communication. Even in going from the wharf to my own Government House I had to be carried in a hammock, and this fact will give you some idea of the difficulties Mr. Dixey had to contend with in travelling all over this country. All he could do was to walk, and could take no luggage except what could be carried on the heads of his carriers; and I may say that on many of his travels he was accompanied by Mrs. Dixey, who braved all the risks of the journeys with him, and all the discomforts, which were perhaps more serious. The next thing that impressed me was how little was known about the country. A small book had been written on the botany of the place by Mr. Leighton Bell, who had been Conservator of Forests before my time, but beyond that little was known. The maps were not based on any scientific survey, but solely on time and compass surveys made by District Commissioners, and many of these are buried away in Sierra Leone and not being made use of. Further, I may say that every village you see marked on the map is temporary. It is apt to be burned down, and the people move, so that a map of accuracy uncontested at one moment becomes very misleading to travellers a little time later. Beyond the botany practically nothing had been done. Mr. Scott Elliott had visited Sierra Leone and spent a short time there, and had written something about the geology of parts of the country. I had hoped, had finances permitted, that even though the Colony is poor and small, it might have afforded one scientist at a time to make surveys and give some sort of account of it, and it was a very great pleasure to me when the Home Government thought it would be advisable to have a statement of the mineral resources of the Empire, and they asked me whether I would consent to have a geologist sent out to examine the resources of Sierra Leone. I was only too glad to agree to this, and it was a matter of very great satisfaction to me when they sent out Mr. Dixey, who has University qualifications, and is a specialist in the subject, and whose knowledge cannot be questioned by any one. The value of a scientific knowledge of a country is apt to be underestimated by people who belong to the older school of officials. I remember quite well when a geologist first came out to the Federated Malay States and expressed an opinion during his first year, one of the older officials said, "This fellow seems to think that geology is the same sort of thing out here as it is at home." That, I am afraid, is the attitude of a great many men even now, but at the same time the value even from the most sordid standpoint of a geological survey can be shown by the fact that at various times people have endeavoured to float companies in London on the strength of the absurd stories about the mineral wealth of the interior. Mr. Dixey at least shows the likelihood of these stories being true. There is another point to which he made only one short reference which is not directly connected with the geology. He mentioned certain forests where anthropoid apes are to be found. Now this may seem a small matter, but nevertheless the existence of these apes was, until recently, doubted by every official. They were said by the natives to attack human beings and even to kill them, and owing to the credulity of the officials when a child was brought in which was said to have been killed by one of these apes, it was generally believed to have been due to

human agency, and police proceedings, often for murder, might follow. We had found recently that these anthropoid apes do exist, that they do attack children, and specimens have been found. The measurements of the arms and girth and height and skulls have been brought to London, and it is doubtful at present whether they belong to a large species of chimpanzee or are really a small variety of the gorilla; but I may say that no less than seven children were killed in the district by these anthropoid apes, and no less than twenty-one apes were killed by the natives shortly before I left. I mention these facts to show the value that science has even in the ordinary details of administration. During the last two or three years we have prepared a geography of Sierra Leone, and to that geography Mr. Dixey has contributed a very valuable chapter on the geology of the country. We have a periodical to which the officials contribute, and in which we hope by degrees to collect a great deal of valuable information about native customs. We are publishing grammars and dictionaries, and I hope that the work of which you have heard Mr. Dixey's account this evening, will be continued not only in geology but other branches of science, until we know fully all there is to be known about this small but interesting Colony on the west coast of Africa.

Dr. J. W. EVANS: I should have been glad had Mr. Lamplugh been able to stay, because it would have been a source of great satisfaction to him I am sure that Mr. Dixey would not hear of any of the escarpments in the country being due to faulting. Mr. Lamplugh has always taken up the position that escarpments should not be explained by faulting when there are other ways in which they could have been produced. I have been very interested in following Mr. Dixey's account of the surface features of the country, and of the problems to which they give rise. The almost entire absence of fossiliferous formations makes it very difficult to follow out the history of the changes which have taken place and produced the present contours. There is a series of very ancient formations, consisting largely of crystalline rocks. These have been worn down in many places into plateaux, one above and behind the other, and we naturally want to know the agency by which they have been produced. There is a great river system which presents many interesting features, and Mr. Dixey brings forward reasons for believing that it represents an imposed drainage—that is to say, the direction of these rivers was determined when the whole country was covered by deposits which have now almost entirely disappeared. I am inclined to doubt whether the formation of the plateaux was due to marine action. That was no doubt the case with some of those close to the present coast, but in many parts they seem to have been due to aerial agencies, especially the action of the wind, of blown sand, and of solar heat. All those rounded hills he described are typical of the effects of the intense heat in tropical regions. There are exactly similar hills in India, characterized by eccentric cracks, which seem to be due to this cause. When the surface is strongly heated it expands and becomes greater than the interior, and naturally bends up away from it or warps, so to speak. Where there is, on the other hand, a more or less flat area the cracks may be horizontal. I have seen in South America, in a broad river-bed, crystalline rocks similar to those described this evening, traversed horizontally by a series of cracks which cut across all their minerals and structures, and in the same way in those rounded hills the concentric cracks cut across them.

Another interesting question raised by this paper is how far is the apparent elevation of the land real, and how far is it due to depression of the sea? I am under the impression that Mr. Dixey says that this elevation is different in

different places. That is a very important point. If it varies from point to point it is probably due to land elevation, and it is rather difficult to see, if the elevation does vary from point to point, how that could occur without faulting. In these hard crystalline rocks there is little folding—they are too rigid for that—and they yield to the force which affects the Earth's crust rather by fracture than by folding. I think I have said enough to show that there are a great number of problems raised which Mr. Dixey has dealt with in a very interesting manner, but which he will himself admit have not yet been completely solved, and it will be many a long day before they are.

Mr. A. D. N. BAIN: I should like to say with regard to the flat-topped hills of the Bauchi plateau of Northern Nigeria that they are composite, and could not possibly be regarded as marine deposits. They are frequently flat-topped, but contain layers of unlaminated clay, and in some cases decomposed layers of basalt, in which the outlines of the felspars are still traced in the micro-sections of the clay. They are usually capped by a vesicular ironstone, and often at the base there is a coarse rounded tin-bearing gravel, and all the evidence seems to point to continental origin rather than to marine origin. The plateau is about 4000 feet high, and the flat-topped hills may rise above that anything to 200 or 300 feet.*

The PRESIDENT: I was very interested to hear what the Governor of Sierra Leone had to say about the scientific activities of his officers in this comparatively little-known country. I can assure him this Society will only be too glad to help officers serving under him to add to our knowledge of the geography of the region. An immense amount of work can be done by civil officers, military and police officers, and others in these out-of-the-way parts, and we have one excellent example of what a civil officer can do, with a little training here and by the use of his own faculties, in Mr. Philby, who was in here this afternoon, having just returned from Mesopotamia, and who received our Gold Medal the year before last. He studied surveying himself, with assistance from here, and by that means was able to make an excellent map on his wonderful journey across Arabia. I met him just now going off with some more instruments from here which he was taking out to the part of Arabia bordering on Palestine. We instruct officials who are going into the Colonial service; we have classes of about sixty at a time, and we are very anxious to develop this field of our activities, and keep in touch with those young men after they get into the Colonial service, and we hope that they will be able to do not only very valuable service for their own Colony, but also contribute to our science. I know you would like me now to thank Mr. Dixey for his valuable paper, and we hope he will come amongst us again and give us the benefit of his experiences in Nyasaland.

Mr. DIXEY: I wish to thank those who have taken part in the discussion for their very kind remarks, and particularly Mr. WILKINSON for the account he has given of my efforts in Sierra Leone, and some of the difficulties he has had there. He was kind enough to mention that my wife accompanied me on two out of my three journeys, and I think it is only fair to say that were it not for the assistance my wife gave me it would have been impossible for me to have given anything like the amount of thought that I have given to this paper. With regard to Dr. Evans' remarks: I quite agree that the problems are by no means solved, and I am sure it will be understood that my view of them has arisen just in the course of my field work; and since my direct connection with

* Falconer, 'Geological Survey of Nigeria,' Bulletin No. 1, pp. 35 *et seq.*, Pls. IV. and X.

the country has ceased, I hope that the evidence which I have found there may be of some value in helping to solve these problems. As regards the question of the uplift of the land or the fall of the sea, that is one I left severely alone! With reference to the different uplift in different parts of the coast, that apparently has taken place, but how far the areas of different uplift are separated by faulting I do not know—probably nobody else does, but I have not been able to get any direct information bearing upon that, and certainly as far as Sierra Leone is concerned there does not appear to be much difference, taking the country from one end to the other. The whole is a very small area.

NOTES ON ABYSSINIAN LAKES

Arnold Hodson

ON a recent visit to Addis Ababa I travelled up *viâ* the chain of lakes instead of going by the main caravan route which travels through Kasse to the west.

Lake Awasa is a pretty lake, but the fishing unaccountably poor. An extraordinary fact is, they say there are no crocodiles there: I certainly never saw one the whole time I was in the neighbourhood. This is quite unaccountable to me, as the lakes below are full of them. I was much tempted to swim as the water was so clear and delicious, but I did not want to make the solitary exception which proves the rule. The natives use a flimsy kind of canoe, made entirely of reeds. They only seat one person and are very insecure and uncomfortable. The canoes on lake Abaya are far more stable.

I travelled up the east of the lake some distance from its shores till I reached the large swamps called Wando. These used to be full of water, but are now gradually drying up. Wando is just over the boundary of Sidamo, and in Arussi province. This province is not under one chief like Sidamo, but is divided up amongst several.

There were some very deep, narrow, swift streams here in which I tried to catch fish, without any success. The natives, I am told, pound up the leaves of the tree called Birbirra, which they throw into the water, and which has the effect of stupefying the fish. There is a hill here called Awaro where Satan is popularly supposed to reside, and also the mountain Nyala, which is more interesting. I crossed over these mountains, and then came to the village of Shashamana. All this part of the world is very much deserted owing to the inroads of brigands from Kasse and Alaba. Here I noticed one of those sticks by the roadside which the Gallas use to commemorate the death of a great warrior. This was about 15 feet high. The first foot had the bark on, and from the second it was removed, and so on right to the top. It rather reminded me of those black and white sticks used in surveying: on the summit was perched a bullock's skull and horns, and a few feathers.

From Shashamana the following hills are to be seen, running from south to north: Abaro, Duro, Albaso and Alutu, and in the far distance Mount Zukwala, which is a sacred mountain and the resort of many priests. To the west lie the mountain ranges in Kasse and Kambata. I was shown a strange phenomenon in this district. There is a small hole in the ground which emits a strong current of air. I suppose it must be the exit of some underground cavern.

Lake Zwai—often called by the natives Dambal—although close to Addis Ababa, seems to be little known.* It is an extremely pretty lake. Starting from the south, where the Suk-Suk river leaves it to flow into lake Hora Abyata below (wrongly marked on the maps Hora Daka), one travels up a broad plain of alluvial soil, devoid of timber, except on the edge farthest from the lake where it is bounded by bush country, and in many places magnificent trees. All this open tract of country is grazed over by herds of cattle, sheep, and goats. In the rains, when the lake rises, it is completely covered with water. On the north-west corner of the lake it is bounded by a thick belt of bush right on the water's edge.

In the lake itself there are five islands—Dadacha, Tulu Guda, Funduro, Dabra Sina, and Galila. The largest of these is Tulu Guda, which consists of two hills, one being called Guba Mote and the other Gumerge. On this island the Abyssinians have a prison for important political prisoners, and there is also a church and some priests. The islands are inhabited by a people called La-Ke, who speak a language peculiar to themselves. The shores of the lake are inhabited by Gallas. I noticed amongst them two sections called Gona and Wata, which is interesting, as two sections of this name are found right down in Boran in the south. The lake appeared to be perfectly healthy, and in February there were no mosquitoes.

I have now seen all the lakes from Zwai to Chamo, and they are puzzling. I was never able till the other day to find out how the name "Chamo" originated. It is called by nearly every one Abaya, the name given to the lake above it, with the exception of a small tribe called Burji who live to the south-east of it, and who call it Chamo.

Lake Zwai in the north is fresh. The lake below it, Hora Abyata, is salt. It has some hot springs on its shores. The lake lying to the east of this has several names—Hora Oitu, Hora Robi, Hora Daka, and Langara. It also is salt. There is a stream, about 25 yards broad, called Hora Kala or Hora Gato, flowing from this lake to Hora Abyata. The water of this stream, though brackish, is drinkable. There is no opening between Hora Abyata (marked Hora Daka on the maps) and lake Shala as shown on the maps. Sometimes after heavy rain the water in Hora Abyata rises and flows over its banks into lake Shala. The latter is salt. Lake Awasa lying below this is fresh.

* One of the best accounts is that of the French traveller Le Roux (see *Journal*, Vol. 25, p. 676).—ED. *G. J.*

To summarize, then, we have:

Lake Zwai	Fresh water.	No crocodiles.
„ Hora Abyata (marked on maps Hora Daka) ...	Salt „	„
„ Langara	„ „	„
„ Shala	„ „	„
„ Awasa	Fresh „	„
„ Abaya (Margherita) ...	„ „	Crocodiles.
„ Chamo	„ „	„
„ Stephanie	Salt „	„
„ Rudolf	„ „	„

Why are some of these lakes salt and some fresh, and why are some full of crocodiles and others not?

British Consulate, Southern Abyssinia,
13 February 1922.

THE MOUNT EVEREST EXPEDITION, 1922

A RATHER long silence, while the expedition was on the march through Tibet, was most happily broken on June 9 by the news that on May 21 Mr. Mallory, Major Norton, and Mr. Somervell reached 26,800 feet without the use of oxygen; while on June 16 came another brief message, that on a date unspecified Mr. Finch and Captain Geoffrey Bruce, using oxygen, had reached 27,200 feet. Simultaneously with the first came two despatches from General Bruce, dated April 30 and May 14; with the second a very long and interesting despatch dated May 28, including a graphic account by Mr. Mallory of his climb the week before.

The rather confusing order in which these various messages have been published makes it desirable to attempt a summary of the events in order of date, with reference to the map made by Major Wheeler in his photographic survey last year, and to photographs taken on that reconnaissance. But the process of translation into "telegraphese" and subsequent retranslation in London (at high pressure for the following morning's paper) has sometimes obscured the original topographical clarity of the messages, and it is not always quite certain that the following interpretation is correct.

The expedition left Darjeeling on March 26 and 27, reaching Phari on April 6, and Kampa Dzong April 11 or 12. Here they were overtaken by Messrs. Finch and Crawford with the oxygen gear. Travelling by Tinki and Shekar, and thence due south over the Pang La to the Rongbuk valley, they were established in their main base camp by April 30, some 14 miles up the valley from Chöbuk, and apparently just

by the snout of the main glacier in the middle distance of photograph No. 14, *Journal*, October 1921, some 2 miles below the junction of the East Rongbuk valley, seen on the left in that picture. General Bruce had hoped to get the main camp higher, but the yak drivers and owners were unwilling to face the rough road along the moraine of the glacier.

About May 1 they started building stone huts for Camp I., apparently in the gap under the letters AC in the above photograph, at 17,600 feet.

On May 5 Strutt, Longstaff, Morshead, and Norton started from Camp I. to reconnoitre the way up the East Rongbuk glacier, which, it will be remembered, had never been completely traversed in 1921, though Major Wheeler had made photographic stations a long way up, on both sides of the valley. Two of his photographs are published as Nos. 10 and 11 of the series in the *Journal* for February 1922.

On May 6 they established Camp II., at heights given in different despatches as 19,360 and 19,800 feet. If the former is correct, the camp would be at Wheeler's station, which was just north of the tongue of the hanging glacier shown in photograph 10, about over the R in the last word of the title; if Camp II. is at 19,800, which from times and distances seems more likely, it would be at the foot of the steep slope in the middle of the picture, above the word "of" in the title.

On May 7 the party had great difficulty in crossing the large side glacier shown in photographs 10 and 11, being held up by a great trench 100 feet deep, which is perhaps that shown at the bottom of photograph 11. They returned to Camp II. that night.

On May 8, making use of a way across the trench discovered by Morshead, they reached the head of the glacier under the Chang La, and established Camp III. at the foot of the steep but safe cliffs of Changtse (photograph 14, February 1922) at about 21,000 feet. If the contours on Major Wheeler's map are right, this camp would seem to be rather higher than 21,000 feet. The reconnaissance party seem to have gone down again from Camp III., to which Mallory and Somervell started on May 8 for a reconnaissance of the Chang La.

On May 13 they gained the Chang La, whose condition seems to have been much more formidable than when Mallory, Bullock, and Wheeler reached it without serious trouble in September of last year. They began a camp on a shelf just below the col, which for convenience we will call Camp [IV.], the square brackets denoting that the number is not given by the expedition reports. They then apparently went down again to Camp III.

On May 15 Strutt, Morshead, and Norton came up again to Camp III. with a large convoy of stores, and on May 17 more tents and stores were carried up to Camp [IV.].

In the judgment of Colonel Strutt, who was in command at Camp III., the time had now come for "a full-dress reconnaissance" without oxygen. On May 19, therefore, Mallory, Morshead, Norton, and Somervell, with

Outline Map of Mount Everest and its Northern Glaciers, reduced from the Photographic Survey of Major Wheeler, R.E., Survey of India, 1921.

nine porters, slept at Camp [IV.], and next day with five of the nine porters made a camp—which we will call [V.]—on the arête at 25,000 feet, the porters going back to Camp [IV.] the same afternoon, and to Camp III. next day.

On May 21, Mallory, Norton, and Somervell climbed from Camp [V.] to 26,800, not quite reaching the shoulder behind the pinnacle 27,390. Conditions were not favourable, since newly fallen snow covered the ledges and concealed loose stones, but the ground was not really difficult, and when the party turned back at 2.15 they judged that they could have gone higher, but might not then have been able to get back.

Picking up Morshead who had remained at Camp [V.] with frost-bitten hands, the party descended with much difficulty, finally reaching Camp [IV.] in the dark after 11.0, to find that the porters who went down the day before had taken all the cooking-pots. Next morning, May 22, they got back to Camp III. after a long and painful descent, suffering severely from thirst, and three of the four more or less frostbitten.

Meanwhile, Finch, Wakefield, and Captain Geoffrey Bruce had been making trial trips with the oxygen gear, and had made various adjustments, with most promising results. About May 27 or 28, Finch, G. Bruce, and one Gurkha N.C.O. spent two nights at Camp [V.] and the first two, or perhaps all three, reached 27,200 feet with oxygen.

No details of this last performance have come to hand, and we do not know if they were going all out to reach the summit, or were on another "full-dress reconnaissance." The great importance of their effort—apart from the creation of a new altitude record—is that they must, so far as one can judge, have found it possible to carry the oxygen to 25,000 feet without using any: which greatly improves the chance of ultimately gaining the summit.

The expedition of 1922 has therefore already three first-rate feats to its credit. Two different parties have camped at 25,000 feet, 400 feet higher than the Abruzzi record climb, and 1500 feet above Meade's record camp on Kamet in 1914. The first party beat the height-record by no less than 2200 feet and without oxygen; the second, with oxygen, beat the first by 400 feet.

With these initial successes realized, the possibility of a final glorious success seems to be much nearer. Theoretical considerations, as put forward by the late Dr. Kellas, showed that about 25,000 feet might be a critical point; yet Mallory is able to write of reaching nearly 27,000 feet "with little or no more physical discomfort than here at the base camp." Pressure-chamber experiments had led Prof. Dreyer to recommend that oxygen should always be used over 23,000 feet, since at that height (nominally) Somervell had shown signs of collapse in the experiments. Yet we find Somervell on the mountain triumphantly reaching 26,800 feet without oxygen, and coming down the only one of the four unfrostbitten. We find moreover that the cylinders can be carried to 25,000 feet without

using the gas on the way: and that the gas supply could be interrupted for a while, at least during the experiments on the mountain, without inconvenience or apparent risk.

One may say therefore that the first trials have shown the physiological difficulties less serious than was anticipated, and that success will depend on two factors: adequate supply at the highest camps, and the recuperation of those who have already made a great effort. Will Mallory, Norton, and Somervell be fit for another great effort after a rest at the base camp? Opinion is greatly divided; and we may be allowed to take the sanguine view that, since the physiological factor is evidently more favourable than one thought, the climbers engaged on a "full-dress reconnaissance" may, with a little nursing at the base, be fit to climb again another day.

With the keenest anticipations for its immediate future we close this brief analysis of the campaign's initial stages. The Mount Everest Committee have telegraphed their warmest congratulations to the two record-breaking parties, and to the General whose organization has made the success. Every one who follows the fortunes of the expedition—that is, a great part of the civilized world—will be anxious to hear that Mallory's frost-bitten fingers are cured, that Norton's ear has returned to its normal size, and that Morshead, who unfortunately suffered more, has at least received no permanent harm. Before this number is published what we have written will be out of date, and more records broken; but whatever happens, the elation of the first good news will remain in the memory of 1922.

REVIEWS

EUROPE

The City of London.— **P. H. Ditchfield.** London: S.P.C.K. 1921. Pp. vi. + 126. 4*s. net.*

THE difficulty of compression which has faced the writers of most of the volumes in this "Story of the English Towns" series probably reached its climax when Mr. Ditchfield tried to compress a vivid history of London town into a hundred and twenty small pages. As is the case elsewhere in the series, the author is more interested in mediæval than in modern life; and the history of "the 19th century and after" is condensed into one of the fourteen short chapters. It may be noted that on p. 28 Fitz-Stephen's statement that at the end of the Norman Period London provided 20,000 horsemen and 60,000 infantry is quoted as evidence of the size of the city, without comment. A total of 80,000 fighting men would indicate that the population from which it was drawn numbered not much less than half a million—an incredibly high estimate for the period, when the total population of England was little more than one million. The book contains little of directly geographical interest; but it is a useful compact summary of much of London's history, with a strong emphasis on its ecclesiastical and architectural aspects. It is also an enthusiastic pæan in praise of "the glory that is London." C. B. F.

The Lake of Geneva.— Sir Frederick Treves, Bart., G.C.V.O., C.B., LL.D., Sergeant-Surgeon to his Majesty the King. *With a Map and* 100 *Illustrations from Photographs by the Author.* London: Cassell & Co. 1922. 25*s. net.*

This attractive volume contains relatively little for the geographer. In Sir F. Treves' pages and pictures landscape serves chiefly as a background to the human homes and interests it frames. He gives us here the fruits of an industrious holiday, spent partly in visiting and photographing the prim little towns or picturesque chateaux that cluster along the shores of Lake Leman, partly in picking up among the handbooks in the library of the Baths of Evian scraps of local story and legend. It would have been well had he been content to make full use of the material thus acquired. But his leisure, or his energy, has led him to attempt to link with it a topographic description of Geneva, and to dip into the numerous volumes dealing with the great names connected with the town for scattered anecdotes. These occupy a disproportionate space, yet neither is complete. In his walk through Geneva he passes by the finest house in the town, the De Saussure mansion in the Rue de la Cité, where Napoleon lodged in 1800, and the old buildings of the Collège, and he makes no mention of the Academy which attracted so many of our countrymen in the years before the French Revolution. The list of celebrities is sadly incomplete, and in that, oddly enough, on the medical and scientific side he omits the great doctor of the eighteenth century, Tronchin de Saussure and De Candolle. Nor have these personal sketches been united by any historical framework. The reader looks in vain for any outline of the story of Geneva. He will learn nothing here of its religious struggles and its political disorders, of its singular and precarious position as an outpost of republicanism, wedged between France and Savoy, and dependent for its existence on the support of three of the Swiss cantons. Sir Frederick tells, it is true, the story of the famous Escalade at some length, but it is as an unconnected episode.

It is not our business here to do more than point out the shortcomings indicated. This volume will interest and attract travellers mainly as a sumptuous guidebook. The charming collection of photographs will suggest objects for their excursions to visitors to Geneva or Evian; the romantic tales or legends the author recounts connected with the castles and shrines round the lake may help to pass their evenings; his vivid descriptions of the beautiful country on the Savoy shore will bring back pleasant memories of an unspoilt and homely region. Much of the volume is fragmentary, discursive, desultory, but it is never dull. It should help to draw attention to an aspect of alpine scenery that has of late years fallen into undeserved neglect, the sunny lowlands and foothills dotted with tiny towns that have lost little of their antique character and bucolic charm. How many of our countrymen have visited Gruyères, where the cheeses come from, a hill town surrounded by a battlemented wall "within which the houses are herded like white sheep in a pen," beneath a massive castle, the whole looking like a town in a story-book or in an Albert Dürer engraving? D. W. F.

ASIA

Michael D. Volonakis: The Island of Roses and her Eleven Sisters. London: Macmillan & Co. 1922. Pp. xxv. + 438. 40*s. net.*

This is a rambling, unmethodical, unscientific, sometimes inaccurate, generally interesting and charming account of Rhodes and the other islands which make up the group commonly called the Dodecanese, taken from Turkey

by the Italians in 1912 and still (in spite of more than one treaty) occupied by them. The greater part of the book is taken up by a history of the islands—that is, practically, a history of Rhodes; and this is well done, except that hardly any attempt is made to describe the general conditions of the world of which Rhodes was a part at the different periods; so that such a period as, for example, that of the Byzantine Empire, when the islands had no independent history, is very inadequately done. This is a serious fault in a book which is obviously intended for non-specialists. Thus the author implies (pp. 97–8) that the islands were equal and willing allies of Athens in the Delian Confederacy; and no explanation is given why Rhodes opposed Philip of Macedon and, with equal patriotism, supported Alexander; nor of the presence of the Rhodian admiral Memnon in the Persian fleet which opposed the latter. The best chapter of the book is perhaps that on the Knights of St. John, where a detailed account is given of the two principal sieges of Rhodes by the Turks; though here again, what we should most have liked to see, an account of the relations of the Knights with the islanders, what each party thought of the other, is absent. The chapter on the prehistoric period might almost have been written by Diodorus (a writer M. Volonakis is fond of quoting).

Equally unscientific, and, it must in fairness be said, without any pretensions to scientific value, are the chapters on geography, geological formation, climate, and flora and fauna, etc. The following quotation from the chapter on climate is a not untypical specimen of much in the book:

"Hippocrates, the father of medicine and an illustrious son of the Dodecanese, said that the cities that faced towards the east were the most favoured climatically. This statement is fully borne out in the Dodecanese, where the climate is not only delightful, but is generally recognized as being the finest in the whole Mediterranean.

"But, of the twelve islands, Rhodes and Cos have been the two most frequently selected for praise, and chosen as places for residence by persons well known in history.

"Thus the Prince of Physicians, Asclepios, whom Pluto accused of having reduced the population of Hades by his medical skill (Diodorus, iv. 71, 2), advised his sons and their descendants to pass their summers in Cos, an advice apparently also followed by prominent Alexandrians, as we find their names, as well as that of the ruling family of Ptolemies, amongst the visitors to the islands."

In the chapter on literature we read:

"There are many other pursuits and studies, such as astronomy, agriculture, cooking, grammar, etc., to which the Dodecanese made contributions, but unfortunately in the course of time the names of most of the authors, as also their writings, have been lost to us."

When Antigonus tried to force the Rhodians into alliance with him against Egypt, he sent an ultimatum forbidding further commerce with that country, and committed an act of war by seizing ships already on their way. In striving to remain at peace, "the people of Rhodes exceeded the limits of normal diplomacy; they voted to Antigonus and Demetrius decrees of honour, raising up statues to immortalize the kings and appease their wrath."

It will be clear where the charm of this book lies—in its pleasant bias, in the obvious sincerity and simple mindedness of its author, his evident attachment to these islands, which have preserved their Hellenism more pure perhaps than has any other part of Greece, and where, thanks to their privileged position under the Turks, ancient political institutions, such as yearly elected magistrates

and assemblies of the whole body of citizens, and ancient seafaring habits, can —in spite of the Italians—still be observed. At the same time it must be emphasized that the book embodies a great deal of useful and not easily accessible information ; it is also excellently illustrated. There is a remarkable drawing of "the famous Colossus of Rhodes," loincloth and all, bestriding the harbour. A. W. G.

On Secret Patrol in High Asia.— Captain L. V. S. Blacker. London : John Murray. 1922. Pp. xiv. and 302. *Maps and Illustrations.* 18*s. net.*

To those who like reading a thrilling account of a journey across unknown parts of High Asia, Captain Blacker's book will appeal with great force. He was in distant Chinese Turkestan when news was received of an enemy party that was travelling into Chinese Turkestan. It was believed to include Germans, and in any case was bent on mischief. A tiny force of that famous body, the Guides, together with some local Hunza levies, took up the pursuit. Was ever any chase so difficult? That is hard to say, but Blacker and his men risked starvation and also the equally deadly cold, in addition to any ambush that the enemy might well have laid for them. The chase started in Sarikol, the lower valley of the Tagdumbash Pamir, and lay approximately eastwards across the precipices of the Raskam country that serves as a bone of contention between the Chinese and the Kanjutis of Hunza who cultivate patches of land in this almost inaccessible country. It was wonderful how the pursuers chanced to find supplies time and again, when they were feeling very hungry indeed, and the thrill of running down their quarry at a serai in Yarkand, where they burst in upon the Afghans and captured them all, was an experience hadly to be surpassed, for man is first and foremost a hunter. The Guides have certainly gained fresh laurels by the feat that is here described.

From Chinese Turkestan to Russian Turkestan is a long step when the journey has to be made *viâ* Gilgit and Baluchistan, but the same gallant little band re-appears at Meshed and then at Merv. Actually, thanks to their activities, considerable additions were made to our knowledge of Northern Khurasan in the shape of many thousand square miles of survey, and we also learn something of the splendid deeds of the little British force that fought so gallantly to keep the Bolshevists from joining hands with the Turks and their German masters. The book conveys the lesson that Indian troops will do everything that any troops in the world can do under officers whom they know. We also realize once more how much Indian surveyors have increased our knowledge of the unknown lands which surround the great Indian Empire. The book is well provided with maps, and the illustrations are good.

P. M. SYKES.

An Administrator in the Making.— James Saumarez Mann, 1893–1920. Edited by his Father. London : Longmans. 1921. Pp. 330. *Map and Illustrations.* 15*s. net.*

This volume consists almost entirely of Captain Mann's own letters written during and after the war, from training camps in England, from France, and from Mesopotamia, where he was killed by a sniper's bullet at the beginning of the siege of Kufa, during the Arab rising of 1920. He went to Mesopotamia in July 1919 as editor of the *Baghdad Times*, but instead of taking up that post he became an assistant political officer at Umm al Ba'rur, near Najaf, the Shiah Holy City, and the greater part of the letters are written from that place. Mann acquired an influence over the Arabs of his district which, considering his youth and short experience of the country, was remarkable. His energy,

rapid mastery of the language, tact, and enthusiasm triumphed over many difficulties, and his tragic death deprived the Mesopotamian civil service of one of its ablest officers.

The country and its inhabitants are vividly described. The Arab is portrayed as "an inconsequent mixture of the knight of chivalry, the high-spirited child, and the fawning, false-tongued Oriental; he is essentially not an Oriental at all, and his mind, like that of the Jew, is European compared with the Eastern races. Altogether he is a funny customer; and the hardest thing about him is that he doesn't really know his own mind, and has only the vaguest idea of what he wants, beyond the one common to all mankind, that wealth would pour down upon him without labour from the skies." In another letter, which proved prophetic, Mann wrote, "I believe that we can build up an Arab Government; I think it is a task of extreme difficulty and profoundly worth attempting; but I am sure that you must give us time. We shall pay for it by being occasionally murdered; and you at home will have to endure taunts of Imperialism, perfidy, and the like. If you insist in turning us out you will let loose incalculable forces of destruction." E. H. K.

Among Primitive Peoples in Borneo.— I. H. N. Evans. London: Seeley, Service & Co. 1922. *Map and Illustrations.* 21*s. net.*

This book contains an account of the native tribes inhabiting the north-west part of British North Borneo, and is largely devoted to a detailed description of the *Dusuns*, who form the greater part of the population of the interior of the British North Borneo Company's Territory. The author as a former official was brought into intimate relation with the natives, who evidently much interested him apart from his duties, for he admits cherishing a great affection for them. Consequently he treats his subject in a very sympathetic manner, and the physical character, temperament, good points and weaknesses, and the daily life of the Dusuns are brought vividly before us. The name *Orang Dusun*, or "people of the orchards," given them by others, though not recognized by themselves, is indicative of their life in villages surrounded by coconut palms and fruit trees. Long-headed Indonesians, those living in the more remote villages, and in consequence least affected by white and Chinese "civilization," still afford an excellent opportunity for the study of a primitive people. The author's description of their dress, ornaments, food, houses, domestic life and amusements, of their methods of agriculture, fishing, hunting and trading, their marriage and burial customs, and industries of weaving, basketry, pottery, and iron-working, are full of interest for the anthropologist. Two objects are curiously interesting, viz. gongs and jars. Metal gongs, though not made by them, are much valued, and serve as a sort of currency. In the district of Tuaran there exists a cult of the sacred jars, each of which has an indwelling spirit. Those known as *Gusi* are large jars of ancient Chinese porcelain. Jar burial is characteristic of the Dusuns. Every good Dusun wishes to be buried in a jar, which in its turn is buried in the ground, but at no great depth, so that the tops often show above the soil.

The religion of the Dusuns is distinctly animistic for they believe that all objects, animate and inanimate, have an indwelling spirit. The Dusun has a somewhat hazy belief in a superior deity called Kenharingan, who with his wife, Munsummundoh, created the world and everything in it. A curious rite illustrating their animistic belief is the yearly launching of a small raft or boat with offerings on it in order to bear away from the village troublesome spirits supposed to have assembled on the raft to partake of the offerings.

The other tribes described at length are the *Illanuns* and *Bajans*, inhabiting

the western coast. They are of Malay origin, or, as it is usual to say now, proto-Malay. The Bajans are also found on the eastern coast, where their mode of life has gained for them the name of Sea-gypsies. These peoples compare unfavourably with the Dusuns, for whilst the latter are good agriculturists, hard working and honest, with however an unfortunate fondness for immoderate drinking of their home-made liquor, the Illanuns and Bajans are by nature truculent swashbucklers, and the most inveterate gamblers, their only redeeming quality being a fondness for sport. The Illanuns were notorious in the past as sea-robbers and pirates in the neighbouring seas, and the Bajans were not much better. They are nominally Mohammedans, but the mantle of the Prophet rests lightly upon them, the women having much freedom and going unveiled.

The chapter entitled "Antiquities" is rather disappointing, for the author's finds appear to have been little more than a few stone implements of neolithic type, and some chert flakes. The site of what may have been a neolithic village was partially excavated.

A chapter is given to the subject of the Chinese in Borneo, in which is discussed the interesting question how far the racial character of the natives has been influenced by the Chinese, who for many centuries have settled more or less in North Borneo, and by whom at the present time most of the trading and mining is carried on. Mr. Evans' inquiries certainly point to the conclusion that this influence has been very small.

The artistic sense of these tribes is shown in the patterns and ornamentation introduced into their woven fabrics and basketry.

An outline map is provided of the north-west district of North Borneo, but unfortunately it is very inadequately filled in. E. A. P.

AFRICA

Up Against it in Nigeria.— "Langa-Langa." London: George Allen & Unwin, Ltd. 1922. *Illustrations.* Pp. 244. *Price* 18*s. net.*

Langa-Langa has given us an amusing account of his varied experiences as a political officer in the Northern Provinces of Nigeria. In lifting the veil which too often obscures the work of administrative officers in remote parts of the empire the author introduces the reader to many noted characters —both white and black. There are several charming character sketches, written with a kindly humour, of brother officers in a service which has achieved so much in two decades, but at the cost of many valued lives.

Although the object of the book is to divert, and not to instruct, it should be read by any one proposing to take up an administrative appointment in West Africa. Not only does it give a very good account of the campaigning conditions under which so much of the political work has to be done, but it contains much sound advice on all manner of subjects ranging from the conduct of punitive patrols against truculent pagan tribes and the hanging of criminals down to the shooting of big game and the idiosyncrasies of native servants. Not the least pleasing feature of the book is the author's keen appreciation of the work of his brother officers, combined with marked reticence on his own achievements.

The book will naturally appeal most keenly to readers acquainted with Nigeria, but it is so full of good stories and tales of real adventure that it may be safely recommended to the general reader. It is well illustrated with photographs, and contains a good map. E. W. B.

The Dual Mandate in British Tropical Africa.— The Right Hon. Sir F. D. Lugard. Pp. xxi. and 643. Edinburgh and London: Blackwood. 1922. 42*s. net.*

Sir Frederick Lugard has given us in 'The Dual Mandate' the result of an experience probably without parallel in tropical Africa; experience reinforced by knowledge gained in other tropical lands—India, Burma, and Hong Kong—and by study of the methods of other nations holding tropical dependencies. His aim has been "to make some useful contribution" to a study of the principles which should guide British administration in tropical Africa, and the utility of his contribution is beyond doubt. His is the kind of book which thoughtful officials have long desired, and it should prove of great value to all who have any responsibility for the well-being of our African possessions. This responsibility extends, though many may be unconscious of the fact, to the industrial classes of Britain. Therefore Sir Frederick Lugard is doing good spade work in insisting on the need of an understanding of the close relation between the economic well-being of this country and the right governance of our colonies and protectorates.

"Europe is in [tropical] Africa for the mutual benefit of her own industrial classes and of the native races in their progress towards a higher plane. . . . It is the aim and desire of civilized administrations to fulfil this dual mandate." That is the author's faith, and he gives the reader ample means of forming a judgment as to how the mandate is being, or should be, fulfilled. One cannot praise too highly his lucid and judicious presentation of facts—the care with which the arguments for or against any particular policy are set forth.

As to the method adopted, the book is divided into two parts, the first (and shorter) part dealing with the acquisition of the British possessions in tropical Africa, the principles governing their control, and the machinery of administration. Some account of the peoples and the physiography of tropical Africa is also given. Part II., entitled "Special Problems," deals, among other things, with taxation, land tenure, labour, slavery, education, justice. The only omission to be noted in this survey is that Sir Frederick Lugard practically ignores European contact with Africa before the opening up of the interior, yet such names as Slave Coast, Gold Coast, and Ivory Coast indicate the reasons for which white men first traded with tropical Africa. Nor in the 'eighties, during the partition period, were the motives of the European nations eminently altruistic. The "mandate" in those days was not dual but singular, and too many white men still regard what they call the "development" of Africa with a purely self-seeking aim. Happily the exploiter has now pitted against him the force of public opinion, a public opinion which has ripened rapidly of late years, and which administrators like Sir F. Lugard have done much to strengthen.

None of the problems discussed equals in importance that of the future of the African races, a future intimately connected with the struggle between Islam and Christianity for their spiritual allegiance. Of the danger attending official partiality towards Islam, either in Nigeria or in the Sudan—and the charge that partiality is shown cannot be wholly refuted—Sir Frederick Lugard is well aware. On the main thesis he holds the only wise position, namely, that the African should be helped to attain the highest development of which he is capable. In the long run tropical Africa will be what the black man makes it.

FRANK R. CANA.

POLAR REGIONS

Geological Observations in the South Shetlands, the Palmer Archipelago, and Graham Land, Antarctica.— A. Ferguson. (*Trans. R. Soc. Edinburgh*, vol. 53, No. 3, pp. 29–54.) 4 *Plates*. *Price* 6*s.* 6*d.*

A Contribution to the Petrography of the South Shetland Islands, the Palmer Archipelago, and the Danco Land Coast, Graham Land, Antarctica.— G. W. Tyrrell. (*Ibid.*, No. 4, pp. 57–79.) *Price* 4*s.*

The South Shetland Islands are of special interest from the evidence they afford as to the former connection of Antarctica with South America and the southern extension of the Andean mountain system. Evidence as to the composition and structure of the South Shetlands was very scanty. In 1913–14 Messrs. Salvesen of Leith despatched their whaler the *Hanka* on a prospecting cruise to these and some adjacent islands. Mr. D. Ferguson accompanied the expedition to report on the mineral resources of the area, and with praiseworthy enterprise he made an extensive geological collection, took an excellent series of photographs, and recorded his observations in a series of careful notes and sketch-maps. He used his opportunities so well that his memoir forms the most important contribution yet made to the geology of the South Shetland Islands. He describes the lands visited as composed of a platform of mudstones and grits, probably of Jurassic or Cretaceous age, and of three series of volcanic igneous rocks: (1) andesites interbedded with the mudstones; (2) basalts and olivine andesites, with associated intrusive rocks, which he assigns to the middle Kainozoic; and (3) the recent volcanic eruptions of Deception and Bridgman Islands. Bransfield Strait the author regards as a tectonic basin due to the sinking of its floor. He considers that the line of extension of the South American mountain axis with Antarctica is still uncertain, though the resemblance of the volcanic rocks of the southern Andes to those of Graham Land indicates their contemporaneity and genetic association; but the exact line of the connection has not yet been determined.

Mr. Ferguson's rock collection has been described by Mr. G. W. Tyrrell in a valuable memoir which establishes the petrographic relation of the igneous rocks of the Graham Land region to those of the Andes. He confirms the view that they are practically identical and therefore justify Dr. O. Nordenskjöld's name of Antarctandes for the ranges of Graham Land. The available evidence from South Georgia is against Suess's conclusion that that island was part of a loop connecting Patagonia and Antarctica, for the igneous rocks of South Georgia are spilitic, and the rocks of that group are not known from the Andes. The connection, as Mr. Ferguson suggests, is probably by some more direct line across Drake's Strait. J. W. G.

MATHEMATICAL AND PHYSICAL GEOGRAPHY

Meteorology.— R. G. K. Lempfert. London: Methuen & Co. 1920. Pp. ix. + 186. *Price* 7*s.* 6*d. net.*

Meteorology.— A. E. M. Geddes. London: Blackie & Son. 1921. Pp. xx. + 390. *Price* 21*s. net.*

Handbook of Meteorology.— Jacques W. Redway. London: Chapman & Hall. 1921. Pp. v. + 294. *Price* 24*s. net.*

These three books exhibit the present state of meteorological science without assuming in the reader an advanced knowledge of mathematics or physics. Mr. Lempfert's book is a development, in the light of more recent knowledge, of his excellent little primer of *Weather Science* published in 1902.

It gives no description of meteorological instruments and the manner of their use; such information can readily be obtained from the special handbooks prepared for observers. It begins with a full description of the weather map as the foundation on which much of the science of meteorology rests, and works out from specimen maps the commoner weather types of which we have experience in Western Europe. The author then proceeds to describe in a convenient order and in greater detail those atmospheric phenomena and conditions which must be known in their causal relations if meteorological maps are to be accurately constructed and correctly interpreted in terms of weather at the Earth's surface at a given time. Of special interest are the chapters dealing with the actual paths of the air involved in a cyclonic depression, with line squalls, the thermal structure of the atmosphere, and the origin of changes of pressure. The book, in short, gives a concise and careful account of dynamical meteorology.

Mr. Geddes' book is described on the title-page as an introductory treatise, and it deals with every branch of the subject as fully and thoroughly as space allows. In an historical introduction the author shows that meteorology, like so many other sciences, can claim Aristotle as its real founder. The instruments used by meteorological observers, including ballons-sondes, the methods of observation, and the interpretation of the results obtained, are carefully described. The general and minor circulations of the atmosphere, water vapour in the atmosphere, and the phenomena of the free atmosphere are adequately treated, and throughout the book the influence of the knowledge of the upper atmosphere, almost entirely gained during the present century, is apparent. Atmospheric electricity, optics, and acoustics are dealt with in short chapters. An interesting section on weather forecasting reveals the care and pains demanded in the construction of the synoptic charts used, and the skill, in which the personal element counts largely, required to interpret them in making forecasts. The extreme complexity of air movements near the Earth's surface must always make accurate weather forecasting a difficult matter. As the author remarks, just as no two finger-prints are identical, so no two depressions have the same weather associated with them. The failures that so often occur in prognosticating the weather for a particular day are not usually due to any failure on the part of the meteorologist to ascertain the nature of the prevailing weather system, but rather to the difficulty of gauging the rate and direction of its travel over a particular region, and of anticipating the sudden intrusion of disturbing factors.

Mr. Redway's book is described on the title-page as a manual for co-operative observers and students. The book is certainly what it was intended to be—a useful book. The first part gives a clear and interesting elementary account of the general principles of the subject, with excellent illustrative instances, usually American. The treatment is in general slighter and more popular than in Mr. Geddes' book. Special features are the subject of atmospheric transparency and the principles of visibility, and folklore regarding weather. The chapter on the dust-content of the air is partly based on the author's own researches. In the second part of the book we have a full description of the instruments used in meteorology, the construction and care of them, and their use, based upon the experience of many observers extending over half a century. There is a most useful appendix of thirty-five pages containing conversion and other tables.

Messrs. Lempfert and Geddes regard meteorology as a science based more and more upon facts of observation, and less upon theoretical considerations.

They accept, for example the views upon the general circulation of the atmosphere arrived at by Hildebrandsson and de Bort as the result of extensive observations all over the world, which disproved parts of Ferrel's theory. Mr. Redway, a countryman of Ferrel, is more conservative. But all three authors agree in regarding the question of temperature distribution as fundamental in dynamical meteorology. The investigations of the upper air have shown that there is a close connection between the pressure at 9 km. above the surface and the mean temperature of the air. And it is probable that conditions at the surface are mainly governed by the pressure at 9 km. above the surface.

W. H. A. W.

GENERAL

Human Geography.— **J. Brunhes.** Translated by **T. C. Le Compte** and edited by **I. Bowman** and **R. E. Dodge.** Chicago: Rand, McNally & Co. Pp. xvi. and 648. *Maps, Diagrams, and Illustrations. Price 5 dollars.*

This is a translation of Brunhes' work, 'La Geographie humaine,' of which the first edition was reviewed at length in this *Journal* (vol. **37**, p. 559). In translation it has been adapted to meet the requirements of American students by the omission of certain sections and chapters, and, at the request of the author, the substitution of the Central Andes for Le Val d'Anniviers as a type of "islands" of high mountains in the section on special studies of natural units. This change does not detract from the value of the book to British students, but we are sorry to find "the footnotes have been reduced in number and restricted to sources available in a geographical reference library." It is surely no disadvantage to have references which may be useful if an exhaustive library or libraries are at hand. Additions to the illustrations and text have also been made to bring out significant facts in American geography. Examples of the working of geographical principles are, however, drawn so widely that English students will not be handicapped in using it. It is the type of scholarly book that is badly needed to raise the dignity of university geography in this country. M. Brunhes, insisting on the physical basis of all geography, reminds geographers that they must continually bear in mind the fundamental facts: facts of unproductive occupation (houses and roads); facts of plant and animal conquests (cultivated fields and domesticated animals); and facts of destructive economy (exploitation of minerals and devastation of plant and animal life). He does not narrow the province of the geographer, but reminds him that many human problems lie on the borderland of the science, and cannot be solved by geography alone. The geographer, for instance, must not usurp the functions of the historian; and while he can, no doubt, throw light on many economic and social questions, he must not presume to explain them in full. The book is very carefully indexed.

R. N. R. B.

Eskimo Folk-Tales.— Collected by **K. Rasmussen.** Edited and rendered into English by **W. Worster.** London: Gyldendal. 1921. Pp. 158. *Illustrations.* 15*s. net.*

Some forty years ago Dr. H. Rink published a considerable collection of Eskimo folk-tales in his 'Tales and Traditions of the Eskimo,' but his volume is long since out of print. The present collection contains some fifty stories selected from a large number made by Mr. Knud Rasmussen in different parts of Greenland. Many of them contain ideas not found in Dr. Rink's collection, and all are charmingly told. No man knows the Eskimo better, and being partly of Eskimo origin Mr. Rasmussen was singularly well qualified

for the task. His full collection, which was made under the auspices of the Carlsberg Foundation, has not yet been published. The tales are delightfully simple and frank, and have a quaintness all their own. They reflect, of course, the hard life of the Eskimo, and many of them dwell on friendship between animals and men. Some of them, Mr. Worster claims, show evidence of derivation from the earliest common sources of folk-lore, and run parallel with legends of other lands and ages. Several of the tales mention inland dwellers, shy and simple people who live in fear of dogs. "There are still some inland dwellers left," says one tale from Smith Sound, "but they are now gone very far up inland." Dr. Rink suggested that the idea of inland people was derived in all probability from the hunting and fishing tribes of the north-west interior of America, and so threw light on the Eskimo origin. Mr. Rasmussen gives no notes to his collection, and thus we miss his explanation. The stories are enhanced by a number of primitive drawings by native Eskimo artists, illustrating typical scenes and incidents that occur in the tales.

R. N. R. B.

The Times Gazetteer of the World.— London: 1922. 18½ × 12 ins. *Price 21s. net.*

This, as the title-page indicates, is really the Index-Gazetteer to the 'Times Survey Atlas,' with which it is uniform in size, and is simply a list of place-names, with the country, latitude, longitude, and map-reference in each case.

Some half-dozen introductory pages are devoted to the pronunciation of certain geographical names. This list would be more useful than it is if it had received a more thorough revision. The pronunciation of the difficult names in Polish, Czech, Magyar, etc., is nearly always given correctly; on the other hand, Russian and Welsh names are often very inaccurately rendered. Several well-known names are wrongly accented; and the division into syllables sometimes disregards the derivation, *e.g.* "Guadalquivir = gwa-dal-kē-vēr', Kilimanjaro = kē-lē-man-jar'-o, Ystradyfodwg = us-tra-duf'-ō-doog." It will be observed from these examples that the system of "phonetic respelling" is an attempt to give purely English equivalents; but long *ē* has to do duty not only for English *ee*, but also for French *u* and German *ü*. We should have been glad to see the R.G.S. II. system employed in this compilation.

La Géographie de l'Histoire: Géographie de la paix et de la guerre sur terre et sur mer.— Jean Brunhes et Camille Vallaux. Paris: Félix Alcan. 1921. Pp. 716, with 39 diagrams. *40 fr. net.*

When two authors of such outstanding eminence in human and social geography, as Prof. Jean Brunhes and Prof. Camille Vallaux, combine to produce a volume of this magnitude, and especially when one expects it to be a piece of typical French work, its interest ought to be at least as great as its importance. Of the importance, especially to the general reader, there is no question; but the book is rather lacking in sustained interest. It will take its place as a book of reference rather than as a treasured friend.

One reason for this may be found in the fact that, along with its dual authorship, it is really two books. Part I. is theory, and Part II. professes to be the application of the theory—to the Great War and the resultant peace or lack of peace; but the profession is scarcely made good. Part I. is essentially a separate book, treating generally the relations of geography and history, especially from the political side. It wanders, rather incoherently, over a very wide field, including statistics and psychology (which does not

disdain even "the psychology of the beetroot"), and lays special stress on the geography of food supply in relation to the distribution of population. In each connection all essentials are noted, but it is all rather commonplace, and one looks in vain for what is new and striking. For instance, in the discussion of Zones of Passive Concentration, the accounts of India and China are almost hackneyed; no geographer doubts that such zones are *naturally* favourable to man, that Zones of Active Concentration are *naturally* unfavourable, that man does not *necessarily* move away from places where life is hard to places where it is easy—(though the steppe is surely *not* one of the latter), and that, if he does move, he does not *necessarily* take the line of least resistance.

The best chapters in this first part are the three devoted to the Three Fundamental Problems of Political Geography (the State and its area, its routes and frontiers, its capital), all pivoting on the underlying idea of man as the greatest of geographical agents. And the fundamental considerations here are behind the most interesting chapters in Part II., which discuss "race," "nationality," "state," etc. Even here, however, the book seems less interesting than it ought to be; it is too vague and too discursive, too much lacking in unity and coherence. Indeed, admirers of the brilliant work that both men have done separately may perhaps be allowed to protest that the dual authorship has hampered both authors.

To geographers the most valuable thing in the book is the insistence on the danger and futility of attempting to give too simple geographical explanations of historic events; to others it will have more value in introducing them to geographical methods of wide outlook and scientific analysis, and in throwing light on the fundamental causes of the various political and economic problems of to-day.

L. W. LYDE.

THE MONTHLY RECORD

EUROPE

The Unification of Greater Berlin.

ALTHOUGH efforts towards the administrative unification of Berlin and its suburbs date back as far as 1875, the desired end was only finally attained in 1920, by an Act which came into force on October 1 of that year. As was the case with London before the formation of the administrative County of London in 1888, the need of such unification was urgently called for, in the interest both of such public services as the supply of water, gas, and electricity, drainage, communications, and the like, and of the equalization of the rating of the various component parts of Greater Berlin. A step forward was made in 1911, when the principal urban districts were placed under a common authority for purposes of transport, building, and settlement operations, but the functions of this body were strictly limited. The provisions of the new Act are briefly described by Dr. Walther Vogel in *Petermanns Mitteilungen* for September 1921, the distribution of population within the new administrative area being dealt with separately by Dr. Otto Schwartz. The new Berlin is an administrative unity possessing virtually the status of a Province. It lies entirely within the Province of Brandenburg, but its only tie with the latter consists in the person of the "Oberpräsident," who acts in that capacity for both. Its governing body consists of thirty salaried members with the "Oberbürgermeister" at their head, and an assembly of 225 members. To

guard against over-centralization, the urban area is divided into twenty municipalities ("Verwaltungsbezirke"), each with its own governing body, to deal with purely local affairs. Altogether ninety-four hitherto independent communities are included, no fewer than eight of which had formerly the status of cities. The area embraced is 877·6 square kilometres, and the population on 8 October 1919 was 3,803,901. With a surface more than double that of Hamburg, Berlin has now a population four times as great. The outlines are very irregular, the greatest extent from north to south being about 30 kilometres, and from north-east to south-west about 45, a distance which the Suburban Railway takes about an hour and a half to cover. In fixing the limits regard was had of course to the probable needs of future development, industrial and other, and also to the inclusion of woods and other open spaces to serve as "lungs" to the city. For this reason the extensions, both in the south-east and south-west, considerably overstep the circumference of a circle drawn with a radius of 20 kilometres from the centre. Within the boundary the greatest diversity in social and industrial conditions prevails, the east and north being (as in London) chiefly the home of the labouring classes, the west and south-west of the well-to-do and middle classes. This is accounted for partly by climatic and partly also by historic causes. The density of population in the separate districts differs widely according as it is reckoned for the whole area or for the area built over, and this is well brought out by the two maps accompanying Dr. Schwartz's paper.

ASIA

Glaciation of the Japanese Mountains.

A convenient summary of our knowledge of the glaciation of the mountains of Japan is given by Dr. N. Yamasaki in a paper read at the first Pan-Pacific Conference at Honolulu in August 1920 and lately printed in the *American Journal of Science* (February 1922). In contrast with the state of things in parts of Europe and North America, glaciation seems to have played but a minor *rôle* in Eastern Asia, and it is only within recent years that accurate observations of past or existing glaciation have been accumulated. As is well known, the most important Japanese mountains occur about the meeting point of the great tectonic axes of North Japan and South Japan. Here the volcanic chain of Fuji occupies an intermediate zone of depression, while the rugged "Japanese Alps" form the north end of the southern arc. But though both Fuji and the culminating peaks of the Japanese Alps exceed the height of 3000 metres, neither group reaches the climatological snow-line, in spite of the high annual precipitation due to the great winter snow-fall. A comparison of the meteorological data for stations at the foot of the Japanese Alps with those for Vienna shows that the temperature conditions, both for the year and for summer and winter, are very similar in the two regions, though the average elevation of the Japanese stations is about 350 metres greater than of the Austrian. Since the Alps nearest to Vienna have their snow-line below 3000 metres, it is clear that only a few hundred metres extra height is needed to bring the Japanese mountains within the limits of perpetual snow. Distinct evidences of former glaciation in the mountains of middle Japan have been found by Dr. Yamasaki and others in the characteristic cirque topography, and are corroborated by the presence of moraines and striæ. The floor of many of the cirques is at a nearly uniform elevation of 2550 metres, which apparently marks the former snow-line. The glaciers must have been hanging glaciers of no great extent, located near the summits of the ridges. So far no

glacial or glacio-fluviatile deposits have been discovered which would permit the exact date of the glaciation to be determined. The small extent of this Japanese glaciation compared with the vast glaciated areas of America and Europe, coupled with the general lack of glacial traces in Eastern Asia even in high latitudes, emphasizes the importance of further research on the conditions in those regions during the glacial epoch.

AFRICA

Ecology of Desert Plants in Egypt.

The *Journal of Ecology* for September 1921 contains some interesting notes by Mr. Hamshaw Thomas on desert plants observed by him when stationed during the war on the margin of the desert west of the Nile delta, where the conditions of plant growth must be about as unfavourable as anywhere in the world, this tract being much more barren than other parts of Egypt and Sinai which Mr. Thomas has visited. Near the town of Ashmûn the desert reaches almost to the left bank of the Rosetta branch of the Nile. West of the railway, which runs parallel to the river, there is about a kilometre of sand-covered alluvium, followed by a narrow strip of hummocks and incipient dunes with scattered tamarisk bushes, which may be regarded as the desert edge. Westward of this a steep ridge of gravel rises some 30 or 40 metres, and beyond it is a vast expanse of undulating country formed of the most barren gravel composed of wind-polished pebbles of quartz or sandstone, with occasional patches of sand capping the hills. The rainfall in this region is mainly confined to the first four months of the year, while none at all occurs from June to October inclusive. The temperature is generally high throughout, though in winter it may fall at night to within a few degrees of freezing. Observations during Rohlfs' expedition of 1873–74 show that it is generally hotter in the desert in the early afternoon and colder at nights than at Cairo, and Mr. Thomas on one occasion registered 115° F. (51·9° C.) in a tent during a sandstorm. The high temperature reacts on plants especially through its influence on the relative humidity, which normally falls as low as 20 and 21 per cent. in the afternoons in May and June respectively. In this gravelly desert, as in another part of the Libyan desert visited by McDougal, it is generally impossible for the traveller to see a single plant around him, but a few herbaceous plants manage to exist for short periods after rain, the most frequent being *Dipcadi erythræum* (a small bulbous Liliaceous plant) and *Monsonia nivea*, a geraniaceous plant, forming small rosettes not more than 2 cm. high. It was not till after heavy rain had occurred on March 20 that growth commenced, and by the middle of April all trace of both plants had disappeared. *Convolvulus lanatus*, a small tufted plant with a woody underground stock, is a conspicuous object when covered with its white flowers; it is plentiful at the desert edge, but becomes rarer in the gravelly desert, being apparently a sand-loving plant which is attempting to colonize the desert, as is also the *Calligonium comosum*. An interesting discovery is that of a minute lichen attached to a specimen of jasper collected in the desert, which has maintained its vitality and increased in bulk since arriving in England. The presence of such organisms in the sand would no doubt provide a favourable nidus for the germination of seeds. Mr. Thomas pays some attention to the question of the root-system of desert plants, a specimen of *Calligonium* obtained showing a more rapid tapering of the root downwards than has been thought usual. Bushes of this plant collect the drifting sand and débris until a mound is formed a metre or more high, apparently covered with isolated bushes,

though these seem to be still connected below the surface. The destructive influence of sandstorms on vegetation is insisted on by Mr. Thomas, who suggests that the close tufted form of some species may be due to the pruning effects of such storms. The poverty of the area described, as compared with the deserts east of the Nile and in Sinai, may perhaps be due not only to greater dryness and less lime-content of the soil, but also to the long separation of the two areas by the Nile.

AMERICA

Delta of the Fraser River, British Columbia.

A careful study of the delta of the Fraser was made in 1919 and 1920 by the Geological Survey of Canada in co-operation with the Department of Public Works, and the results, with special reference to the stratification of the deposits, are described by Mr. W. A. Johnston in the *Journal of Geology*, February–March 1922. A machine was used which furnished core-samples (1) from the sea-bottom deposits in the Strait of Georgia, and (2) from the fresh-water deposits in Pitt Lake, a tidal lake tributary to the Fraser; and an insight was thus gained into the contrast between the stratification under salt and fresh-water conditions. At 100 miles from its mouth the Fraser has an average minimum discharge of 17,000 cubic feet per second, but the yearly maximum may reach nearly 400,000 cubic feet or even more. During low water the influence of the tide is felt for 60 miles, and this largely compensates for the lack of river-water in its lower course during the low stage. The turbidity is high by reason of the large amounts of very fine material carried in suspension, and during the freshet the river-water can be distinguished from the sea-water for from 10 to 15 miles from the mouth. The delta (which has a seaward front of 14 miles) is building out into fairly deep water in the Strait of Georgia, in spite of the strength and range of the tides, because of the dominance of the river over the tidal currents. The higher delta lands are fringed seaward by from 4 to 5 miles of nearly level sandbanks, submerged at high tide, the tidal currents here preventing the river from building up its banks. They also give a smooth curved outline to the subaqueous front, which in places may be nearly vertical for from 1 to 3 fathoms. The beds have an average dip of about 10° to about the 30-fathom line, below which they slope more gradually, while the very fine material forms nearly horizontal beds over a considerable part of the Strait of Georgia. Summing up, the author points out that the alluvial flood-plain deposits show seasonal layers of silt and vegetable material, whilst the tidal flood-plain deposits show a very thin lamination, tidal in origin, with some indication of seasonal influence. The beds of the delta-front deposited in sea-water also show a thin lamination due to the combined action of flocculation, river and tidal currents, and slack water, while the fine-grained bottom beds are thick and without lamination owing to the effect of flocculation. From these facts the author concludes that fine-grained sediments which are evenly and gradationally laminated have a fresh-water origin, or, if marine, are glacial; for only where large volumes of water from melting ice-sheets are poured into the sea would the sea-water, as a rule, be sufficiently dilute to prevent flocculation.

Texas Floods.

Particulars of disastrous floods in the vicinity of Williamson County, Texas, between 8 and 10 September 1921 are given by B. Bunnemeyer and others in the *Monthly Weather Review* for September 1921. The catastrophe, resulting in the deaths of at least 215 persons and damage to the extent of $19,000,000

in Williamson and neighbouring counties, was greater than that of the record-breaking floods of 1913, and was occasioned by a close succession of violent thunderstorms. At Taylor the amount of rain which fell in twenty-four hours amounted to 23·11 inches, which not only exceeds the previous Texas record of 20·6 inches at Montell in June 1913, but is the record for the whole of the United States. Such orders of magnitude are confined to warmer latitudes, and may be contrasted with such English 24-hour falls as 9·6 inches at Bruton, Somerset, in June 1917, and 8·1 inches at Brundall, Norfolk, in August 1912.

Railway Progress in Bolivia.

A good many years have passed since the grandiose project of a great railway traversing North, Central, and South America and bringing the United States into through communication with Buenos Aires was first mooted, but apart from the Argentine portion, little progress has been made towards its accomplishment. A further link in the chain—that formed by the section crossing Bolivia—is, however, well on the way towards completion, and the present position is described by Sr. Carlos Sorzano in the *Bulletin of the Pan-American Union* for February 1922. In 1910 the Bolivian contribution consisted of two sections, disconnected and of different gauge, the one between Guaqui on Lake Titicaca and Viacha near La Paz (68 km.), the other between Oruro and Uyuni in about 20½° S. (325 km.). There is now completed, in one stretch of 685 km. of the same gauge, a continuous line from Guaqui to Atocha, a little beyond Uyuni towards the Argentine frontier. In order to reach this and so to connect with the trunk line already opened from the frontier to Buenos Aires, only 204 km. remains to be completed, and work on this has already made considerable progress. A part had been taken in hand by a French company as far back as 1915, but the war and other difficulties delayed matters, though much important work has been carried out. The contract for finishing the work has lately been given to an American firm, and it is hoped that the whole will before long have been completed. Even apart from the more or less visionary Pan-American project it is claimed that the line will have an important effect in improving South American communications. It will provide a new trans-continental route from the Pacific to Buenos Aires, with certain advantages over the existing Trans-Andine line from Valparaiso to Buenos Aires. The gradient will nowhere be so steep, and although the new line will cross the Andes at a much greater altitude (4350 metres), the difference in latitude will keep it free from the heavy snowfalls which obstruct the more southern line. It will also provide communication between northern Argentina and the Salitrera region of northern Chile, at present reached by the long and difficult route across the desert of Atacama used by the Argentine stock-raisers, and will facilitate the import of merchandise from the United States into northern Argentina *viâ* the port of Antofagasta.

MATHEMATICAL AND PHYSICAL GEOGRAPHY

The Geological Effects of the Cooling of the Earth.

Dr. Harold Jeffreys has published in the *Proceedings of the Royal Society* (Series A, vol. **100**, pp. 122–149; see also *Phil. Mag.*, vol. **32**, pp. 575–591) the results of his mathematical investigations on the thermal history of the Earth. In a previous paper Dr. Jeffreys had already accepted—as Mr. Jeans also was inclined to do—the view that the planets were formed by tidal action in the Sun as the result of the near approach of another star. This, he believes

implies that at an early stage of the Earth's existence it was fluid at the surface, and that its subsequent development took place by radiative cooling without much mechanical interference from outside. He assumes that changes in temperature were practically confined to superficial layers whose thickness is small compared with the radius. As the amount of heat arriving at the surface by conduction from the interior is a very small fraction of that obtained by radiation from the Sun, the surface temperature is considered to be determined solely by the condition that the radiation of heat into space must balance that received from the Sun. He supposes that there has not been in geological time any wide variation in either, and accordingly that the changes in the surface temperature have not been sufficient to demand their recognition. He therefore takes a constant surface temperature for his zero of temperature. He follows Holmes in assuming that the number of calories generated in unit time by radioactivity or chemical change may be expressed by Ae^{-ax}, where x is the depth in centimetres and $A = 1{\cdot}03 \times 10^{-12}$ cal./cm.^{3} sec., and a is another constant which he calculates to be $6{\cdot}5 \times 10^{-7}$/cm. For the purpose of this investigation he takes the initial temperature to be the melting point of the rocks, and supposes this to be expressed by $S + mx$, where $m = 0{\cdot}000{,}05°$ C. per cm., and S is the *melting* point at the surface. This is assumed to be 1,200° C.; but the temperature of *consolidation* would probably be considerably less on account of the presence of volatile constituents. He takes the rate of increase of temperature with depth at the surface to be about 0·000,32° C. per cm. The conductivity of the Earth's crust is assumed to be 0·005 C.G.S., the density 2·8g./cm.^{3}, the specific heat 0·25 cals./g. 1° C. The age of the Earth since solidification is taken to be $1{\cdot}6 \times 10^9$ years in accordance with Holmes' work based on the uranium–lead ratio. The coefficient of linear expansion of the rocks is assumed to be $\epsilon + \epsilon' V$, where ϵ is 7×10^{-6}/1° C. and $\epsilon' = 2{\cdot}4 \times 10^{-8}/(1° \text{ C.})^2$, and V is the temperature. On these assumptions he calculates the amount of compression available for mountain building as a result of the Earth's cooling. He finds that the fraction of its length by which a grand circle of the Earth has been shortened will be $3{\cdot}7 \times 10^{-3}$ for continental areas and $5{\cdot}2 \times 10^{-3}$ for ocean regions, where greater cooling is believed to occur on account of the less radioactivity of the prevalent basic rocks. The area of the land is $1{\cdot}45 \times 10^{18}$ cm.^{2}, and that of the ocean $3{\cdot}67 \times 10^{18}$ cm.^{2}, so that the reduction of the Earth's surface by crumpling is 49×10^{15} cm.^{2}, which is considered to be more than enough to account for all existing mountains. The average reduction of a great circle of the Earth is 170 km.

The rocks under the oceans are believed to be stronger than those under the land, both because basic rocks are more resistant and because they have cooled to a greater extent. The ocean floor therefore will exert an outward thrust, and the marginal rocks of the continent will be driven inland and piled up over those already there.

The author then discusses the isostatic compensation of crustal inequalities. He infers from the above data that the Earth's interior has scarcely cooled at all below a depth of the order of 370 km., "and must therefore still be in very nearly the same condition as immediately after solidification." It will therefore be "extremely ready to flow under small shearing stress lasting for a considerable time." He infers that any inequality capable of producing appreciable shearing stresses at a depth of about 400 km. must cause flow. Consequently any inequality of height more than 200 metres and extent more than 1000 km. should be compensated.

The author attributes the origin of the ocean deeps to the greater cooling

under the oceans, which causes a convex warping and marginal depression, which he calculates would be of the order of a kilometre. He remarks that, the consequent inflow of matter from the border to the centre not being caused by additional load on the former, there should be a true local defect of gravity at sea-level in the deeps, as Duffield's observations would seem to indicate.

The cooling that took place immediately on solidification must have resulted in numerous vertical cracks which became filled with igneous material. It is to this cause that the radiating streaks visible on the Moon's surface may be attributed, while the *maria* represent flows of igneous rock filling depressions.

Reasons are advanced against the supposition that the Pacific owes its origin to the separation of the material of the Moon from the Earth, and also against the hypothesis that the form and distribution of the continental masses are due to tetrahedral contraction of the Earth in cooling.

This brief summary is all that can be attempted here, but it may suffice to show the importance and suggestiveness of Dr. Jeffreys' paper. J. W. E.

GENERAL

International Congress of Americanists.

The XXth Session of the International Congress of Americanists will be held at Rio de Janeiro, 20–30 August 1922. The programme includes the usual meetings for the reading of papers on the ethnology, archæology, and linguistics of the Americas, with visits and short excursions. Following these there will be scientific excursions to the States of Minas Geraes, São Paulo, Espiritu Santo, and Santa Catharina. Facilities for returning by Pará may be also arranged. The museums there and at São Paulo are of especial interest. The strong local committee is under the presidency of Dr. João Teixeira Soares, and new members will be welcomed. Subscription £1, including the Proceedings. Address: Dr. A. C. Simoens da Silva, Vice-President, Sociedade de Geographia, Praça 15 de Novembro, No. 101, 2° andar, Rio de Janeiro. Brazil celebrates the centenary of her independence on September 7, when a great International Exhibition opens at Rio, and a Congress of American History will be held. All the South American Republics will be represented.

Anaximander as Geographer.

The Greek philosopher Anaximander of Miletus has been generally credited with the making of the first map of the world, and he is also known as the writer of a treatise, as to the scope and contents of which, however, no sure information has come down to us. An attempt to gain some light on the subject by a careful examination of the statements of later writers has been made by Prof. W. A. Heidel, in the *Proceedings of the American Academy of Arts and Sciences*, vol. 56, No. 7, 1921. This writer thinks that, while Anaximander is generally spoken of as a philosopher, his book being traditionally described as 'On Nature,' he may rather be regarded as a geographer, as the word was understood in those days. A starting point in the inquiry is the statement of Suidas that Anaximander wrote 'On Nature,' a 'Tour of the Earth,' 'On the Fixed Stars,' 'The Sphere,' and some other treatises. This does not necessarily imply that he wrote several books, for, as the early writers did not themselves adopt titles, these came to be attached for convenience' sake by librarians, and the same book may have been represented by various titles. In any case the titles given must be taken as at most indicating the general scope of his writings. In addition to his map of the world he was besides credited with the invention of the gnomon, and with the construction of a

sphere, a representation of the heavens. That Eratosthenes, who spoke of the *map* made by Anaximander, and of the geographical *treatise* of his successor Hecatæus, did not also credit the former with such a treatise, must be held, the writer thinks, merely to show that Eratosthenes did not regard the matter as fully authenticated. A later writer whose views respecting Anaximander it would be particularly valuable to discover is Apollodorus of Athens, himself interested in geography and chronology. According to Diogenes Laertius Apollodorus lighted upon a "summary exposition" by Anaximander "of his opinions," and in the precise details given as to the age of the latter Prof. Heidel sees an indication that his work must have been rather of an historical and geographical than a philosophical character. He finds confirmation also in the reference to Anaximander (coupled with Dionysius and Hecatæus) as having written on the origin of the Greek alphabet; for there seem good grounds for doubting the attribution of this reference to Anaximander the younger. Another slight but suggestive indication is the reference by Athenæus to the Heroölogy of Anaximander, which may have been one of the works covered by the "certain other Treatises" of the list of Suidas. As this is also given as the title of a work of Hecatæus, it is not unnatural to suppose that Anaximander, like the latter, concerned himself with matters throwing light on early history and geography. It is possible, Prof. Heidel thinks, that Anaximander originated the traditional scheme of historico-geographical treatises traceable through Hecatæus and Herodotus to Eratosthenes and Strabo, which accorded well with the special interests of the Milesians in chronology, descriptive geography, ethnography, and so on. These conclusions are no doubt based on somewhat slight foundations, but they are consistent with such faint indications as are now available, and the study is to be welcomed as suggesting further lines of inquiry on a subject of great interest.

OBITUARY

Stuart M. Vines.

WE regret to have to record the death, at the comparatively early age of fifty-four, of Mr. Stuart Vines, well known to geographers from his ascents of Mts. Aconcagua and Tupungato in the Andes as a member of the expedition of Mr. E. A. Fitzgerald to that region in 1896–97. Besides the Swiss guide Zurbriggen, of the same expedition, who preceded him on Aconcagua and accompanied him during the ascent of Tupungato, he was the only one of the principal members of the party who succeeded in reaching the summit of either peak, and the ascent of Aconcagua was notable as virtually creating a record for altitude attained, since previous claims to the attainment of an equal altitude (somewhat above 23,000 feet) lacked firm substantiation. In this region the climbers had to face unusual difficulties in the form of violent gales, at a temperature far below freezing, and suffered extremely also from mountain sickness, so that it was only after repeated attempts that success was at last attained, first by Zurbriggen, and later by Mr. Vines, accompanied by an Italian porter, Nicola Lanti, after illness had forced the leader himself to desist. The ascent of Tupungato, for which Vines and Zurbriggen were specially detached by Mr. Fitzgerald, involved hardly less difficulty, in spite of its lower altitude of about 22,000 feet (see *Journal*, Vol. **12**, pp. 475–484).

After these feats Vines turned his attention to the other hemisphere, hoping to achieve some ascents among the Himalayan peaks. But the South African

war frustrated his plans, and he served in it with credit, first as sergeant, afterwards as lieutenant. After the war he went to West Africa as Secretary to one of the Colonial Governors, and subsequently did good survey work among the forests on behalf of the Government. He nearly lost his life in the bush through black-water fever, and was invalided home, but subsequently engaged in survey work in the Bahr-el-Ghazal province of the Sudan. But the hardships and illnesses of his life in the African tropics undermined his strength, and after much suffering he died at Torquay on April 7 last. One who knew him well describes him as the staunchest of friends and excellent company.

CORRESPONDENCE

Conversion of Rectangular to Geodetic Co-ordinates.

I have read with much interest, in the March 1922 issue of the *Geographical Journal*, the review by E. A. R. of the two publications entitled respectively 'Factors for Converting Rectangular to Geodetic Coordinates between Parallels 48° and 60°,' by Mr. C. E. Tildesley, of the Department of Lands of British Columbia, and 'Relation between Plane Rectangular Coordinates and Geographic Positions,' by Mr. Walter F. Reynolds, of the U.S. Coast and Geodetic Survey.

In this review attention is called to the fact that when a comparison is made where the latitudes overlap, that is, from 48° to 49°, considerable differences occur in the last figures of the logarithms in the two publications.

A copy of Mr. Tildesley's tables has just reached this office within the last few days, and they have been carefully examined so as to explain these differences. They are due simply to the fact that Mr. Tildesley, in making his computations, has used the English foot, while in the computations made at the U.S. Coast and Geodetic Survey the legalized United States foot was used. The computations in this office were first made in metres and reduced to feet by the relation 1 metre = 3·2808333 feet.

The designations used by Mr. Tildesley are slightly different; his factors, log R sin 1″, log K, and log G correspond respectively to log K, log L, and colog H of the U.S. Coast and Geodetic Survey publication.

If it is desired to make the tables in the two publications consistent, it is only necessary to add 47 in the seventh place to all the logarithms under log H and log K in the Coast and Geodetic Survey publication. Between the factors log K of Mr. Tildesley's tables and log L of Mr. Reynolds' tables there is a difference of less than 1 in the fourth place of decimals. This is due to the fact that Mr. Tildesley has carried his figures to the nearest fourth place of decimals, while the Coast and Geodetic Survey tables are carried to the fifth place.

E. LESTER JONES,
Director U.S. Coast and Geodetic Survey.

Washington, 24 May 1922.

MEETINGS: ROYAL GEOGRAPHICAL SOCIETY: SESSION 1921–1922

Fourteenth Evening Meeting, 22 May 1922.—The President in the Chair.

ELECTIONS.—Thomas Franklin Barratt; Sir Charles Alfred Bell, K.C.I.E., C.M.G.; Leslie Stuart Clinton; William Cobeldick; Lucius O'Brian John Conolly; Brevet-Major Ion Alexander Scott Cooke, O.B.E.; James Douglas Craig; Hugh Langdon-Davies; Captain G. R. H. Deane, R.E.; Samuel Blunt de Burgh-Edwardes; Charles Price Green; Albert D. Helser, M.A.; F. A. Holmes, J.P; Alwyn Douglas Home; William Ault Horton; Harold Rolls Gordon-Miller; Mrs. Mary Morgan; Colonel Alfred Rawlinson, C.M.G.; Owen Roberts; Miss A. J. R. Stratford, B.SC.; Prof. Stephen Sargent Visher, PH.D.

PAPER: The Border Countries of the Punjab Himalaya. H. Lee Shuttleworth.

Anniversary General Meeting, 29 May 1922.—The President, Lieut.-Colonel Sir Francis Younghusband, in the Chair.

The HONORARY SECRETARY (Mr. A. P. Maudslay) read the Minutes of the Anniversary Meeting held on 30 May 1921.

The PRESIDENT: We now proceed to the presentation of the Medals and Awards. His Majesty the King was graciously pleased to approve of the award of the Founder's Medal to Lieut.-Colonel Howard-Bury for his leadership of the Mount Everest Expedition last year. We in this Society are very greatly indebted to Colonel Howard-Bury: in the first place because he went out the year before last at his own expense, on our behalf, to carry through that initial stage of the expedition which was almost the most important of all, to negotiate with the Government of India for permission from the Dalai Lama for an expedition to proceed to Mount Everest. He carried that mission through with great tact and ability, with the result that we obtained permission from the Dalai Lama; and this Society and the Alpine Club then asked Colonel Howard-Bury to proceed to India last year to conduct the first phase of the Mount Everest Expedition, which was to make a thorough reconnaissance of the mountain. He carried this through with conspicuous ability and tact, with the result that they were able to make a complete and thorough reconnaissance of the mountain, and bring back very valuable scientific information. In addition, Colonel Howard-Bury's own photographs, taken with very great skill and artistic insight, have added especially to the interest and value of those results. When he returned he set to work to write a complete account of the reconnaissance, which account was published for the Committee at the beginning of this month. I have great pleasure in handing to Colonel Howard-Bury the Founder's Medal of the Society.

Colonel HOWARD-BURY: I thank you very much indeed and all the members of the Council for putting forward my name to His Majesty the King for the award of this Royal Medal. I look upon the award not only as a personal reward, but as an expression of their thanks and their gratitude to all the members who took part in last year's expedition. They often had a far more difficult, far more dangerous, task than I had. They had to undergo far greater discomforts on many occasions. At the very outset we were unfortunate to lose one of our party. His loss to science was very great, but his loss to the Expedition was still greater. We were unable to carry out those experiments at high altitudes which Dr. Kellas knew so well

how to conduct, and our results were, in consequence, not so good as they would have been had he been present with us to the end. To me it was a very great surprise that I should have been given this Medal on my return. I had only gone out with the spirit and love of adventure that so many of us have to seek new lands, to see if we can in some way add a little to the knowledge of science and of geography. No expedition could have been more interesting, more full of beauties, than the one I was lucky enough to take part in last year. I hope, also, that we have brought back a few results that may be valuable to science; and not only to science but to our gardens, thanks to the work of Mr. Wollaston. We found some new flowers which I hope will before long be available for all those who are lovers of gardens.

I again thank Sir Francis Younghusband and all the members of the Council for the very great honour they have done, not only to me but to all the members of the expedition to Mount Everest in 1921, by awarding me the Founder's Medal.

The PRESIDENT: With His Majesty's approval the Patron's Medal has been awarded to Mr. Ernest de Koven Leffingwell, for his surveys and investigations on the northern coast of Alaska. Mr. Leffingwell served his apprenticeship to Arctic Exploration as a member of the Baldwin–Ziegler Expedition to Franz Joseph Land in 1901, being then quite a young man. On it he became intimately acquainted with Einar Mikkelsen, and the two friends agreed to join forces for a further venture on their own account. After many difficulties had been surmounted, a joint expedition to the Beaufort Sea was at last successfully organized in 1906. On this expedition, which sailed in the *Duchess of Bedford*, Mr. Leffingwell had special charge of the Survey work and also of the Meteorological and Geological observations, and by the pains which he took to acquire a knowledge of the Eskimo language did useful work as interpreter for the rest. He took part in the journey north over the pack ice, and afterwards did independent work on shore. On Mikkelsen's return to civilization Mr. Leffingwell decided to remain in Northern Alaska to continue his geographical and scientific work in the almost unknown tract between the Colville river and the Canadian boundary. Working at his own expense, and without many of the resources enjoyed by well-equipped expeditions, he pursued his work, with but one short return to civilization for re-fitting, until 1914, aided by one other white man only. Besides a careful survey based on triangulation of the coast-line, as well as of a considerable area inland in the region of the Canning river, he devoted his attention to hydrography, geodesy, meteorology, tidal and magnetic observations, ethnology, and zoology, eventually publishing the full results as a Memoir of the United States Geological Survey, which must long remain the basis of our exact knowledge of that remote region. Those best qualified to judge speak in high terms of the painstaking and accurate character of his work, and a result of some practical value was the determination by sounding of a channel navigable for light-draught vessels between the mainland and the outlying reefs and islands. On the scientific side Mr. Leffingwell made a special investigation of the ground-ice in the Arctic, and his observations have enabled him to propound a new theory of its formation. Mr. Leffingwell is of British family, but now a citizen of the United States, resident in Los Angeles, and as it is impossible for him to be present this afternoon, the First Secretary of the American Embassy, Mr. Oliver B. Harriman, has been deputed by the American Ambassador to receive the Medal on behalf of Mr. Leffingwell. We will ask him, in transmitting the Medal through the Department of State, to send with it the cordial greetings of this Society.

Mr. OLIVER B. HARRIMAN (First Secretary, American Embassy): First of all, I desire to say that Ambassador Harvey wished me to express his deepest regret at being unable to be present at this meeting. It affords me the greatest pleasure to have been deputed by him to receive the Patron's Medal of the Royal Geographical Society on behalf of Mr. Leffingwell. The President of the Society has just given in most laudatory terms a sketch of Mr. Leffingwell's achievements and merits, which, unfortunately, Mr. Leffingwell is personally unable to respond to. I shall, however, take good care when forwarding the Medal to transmit to him also the cordial greetings of this Society, together with Sir Francis Younghusband's kind and appreciative remarks. I have the honour to accept on behalf of Mr. Leffingwell this kind expression of the honour conferred upon him by the award made to him by the Royal Geographical Society.

The PRESIDENT: The Victoria Medal was instituted in honour of her late Majesty to be awarded from time to time for conspicuous merit in scientific research in Geography. It is awarded this year to a distinguished student and former member of our Council, Mr. John Frederick Baddeley, for his great work on the Historical Geography of Northern Asia. Mr. Baddeley first visited Russia in 1879 with Count Shuvalov, and was afterwards for ten years special correspondent of the *Standard* newspaper. In his recent book 'Russia in the 'Eighties' he has told an interesting story of his life there. He made a special study of Russian expansion in the Caucasus, which was published in 1908. Meanwhile, from 1900 onwards he had made several journeys to the Far East by way of Siberia, and in 1910 he crossed the Amur and travelled to Tsitsihar by a route which had not been followed before by a Western European. Beginning to study the narrative of Russian envoys who had made this journey in the seventeenth century, especially the work of Spathary, he was led to study the whole history of Russian intercourse with China, and embodied the results in his great work in two volumes—'Russia, Mongolia, China'—which is the particular subject of our Award. It is a monument of careful research, and sheds a flood of light on the historical geography of Northern and North-Eastern Asia. We greatly regret to hear that Mr. Baddeley is detained by illness in Italy, and is unable to be here this afternoon to receive this Medal, which I will ask the Honorary Secretaries to transmit to him with our best wishes for his recovery.

The Murchison Grant is awarded to Mr. Charles Camsell, Deputy Minister of Mines, and Honorary Secretary of the Royal Society of Canada. Between the years 1894, when he graduated at the University of Manitoba, and 1920, when he was appointed Deputy Minister of Mines in the Dominion Government, Mr. Camsell has been almost continuously in the field, as a geologist who, working in unexplored and unmapped regions of Northern Canada, contributed as much to the geography as to the geology of the country. He is the author of many memoirs published by the Geological Survey of Canada, and of a valuable article on the Unexplored Areas of Canada in our *Journal* in 1916. Mr. Camsell is coming to this country this year, but cannot arrive until July. The High Commissioner for Canada has very kindly in his absence undertaken to receive the Award for him.

Mr. LARKIN (High Commissioner for Canada): It gives me great pleasure to attend your Anniversary General Meeting and to accept on behalf of Mr. Camsell the Murchison Award of your Society, and when forwarding it I shall be very glad to advise him of the cordial manner in which the presentation was

welcomed by the members assembled. I do not know of any recognition of his labours which could be more gratifying to Mr. Camsell than the granting by the Royal Geographical Society of the Award bearing the name of so distinguished a geologist and explorer as Sir Roderick Murchison. Mr. Camsell was born in one of the outposts of civilization, a small place in the Mackenzie River basin, which gave him the advantage of becoming familiar in his early years with the methods of travel best adapted to exploring the great North Land, and he has covered much of the country tributary to the Mackenzie river and the Great Bear Lake region, as well as Northern Ontario and British Columbia, and his publications have added much to our knowledge not only of the geography but of the mineral and other resources of these regions. The mark of approval of his work which you have now made will give much pleasure to his fellow-Canadians, and it will be an encouragement to scientific investigation in the Dominion which will tend not only to the advance of knowledge but will assist in the development of the resources of the country. In Mr. Camsell's name I thank you most heartily.

The PRESIDENT: The Back Grant is awarded to a distinguished surveyor on the staff of the Survey of India—Khan Bahadur Sher Jang—who has a remarkable record of work with British Missions in Abyssinia, in Tibet, on the Turko-Persian frontier, in Arabia, the Abor country, and 'Iraq. His chief describes him as a firstrate surveyor with a faculty for getting on as well with British officers as with wild tribesmen, and this Society is glad to add his name to the list of native Indian surveyors whose contributions to geography have from time to time been recognized by our Awards. We are forwarding the Award to the Surveyor-General of India, who has kindly undertaken to present it to Khan Bahadur Sher Jang on some suitable public occasion.

The Cuthbert Peek Grant is awarded to Mr. Frank H. Melland, Magistrate of the Kasempa district, for his exploration in Northern Rhodesia. Mr. Melland has twenty years' service with the Government of that distant country, and is an official of that high type which contributes so much to our knowledge of the country and the people that he administers; always studying the history and customs of the tribes; always mapping by the best methods available to him the territory which is gradually brought under administration. He has contributed several valuable papers to the Society's *Journal*, and besides his many tours on duty in the little-known districts of Rhodesia he took advantage of an opportunity, when proceeding on leave in 1910, to come home overland on foot or on bicycle through German East Africa and the countries of the Upper Nile, making valuable ethnological comparisons, which he published jointly with his colleague Mr. E. H. Cholmeley in 1912. The Cuthbert Peek Grant is given to assist those intending to do further geographical work. We may be sure that so long as he is in Africa Mr. Melland will add continually to our knowledge of the country.

The Gill Memorial is awarded to Mr. A. A. R. Boyce, for his triangulations in the Sudan. Mr. Boyce has been an officer of the Sudan Survey Department since 1906, continuously employed in surveys of the Pibor river, of the Mongalla province, the demarcation of the boundary with Northern Abyssinia, and since 1916 of the new province of Darfur. His most conspicuous work, the subject of this award, was the triangulation he carried in 1917 from Khartoum to Darfur—a chain of triangles 750 miles long, which he observed almost single-handed in arduous conditions. Mr. Boyce is on duty in the Sudan, somewhere so far from civilization that he may not yet have heard of the award. The Honorary Secretaries will convey it to him through the Surveyor-General of the Sudan.

The President then delivered his Anniversary Address, which is printed on page 1.

The President appointed Mr. Patrick Alexander and Commander Elwell-Sutton to be Scrutineers of the Ballot.

The PRESIDENT: We now proceed to the consideration of the Annua Report which is in your hands. I think that the chief point to note is that the Fellowship is larger in the year under review than it has ever been before. You will notice also that the receipts and expenditure are also larger than they have previously been. In fact, the expenditure somewhat exceeds the receipts, that being due chiefly to the expense of publications, which was unusual last year. Our Budget for the present year, however, shows a slight surplus. The affairs of the Society are in a flourishing condition, when you consider the increase of membership, and the fact that the number of those who are paying £3 a year is gradually increasing, whilst the number of those elected before 1908 paying £2 a year is gradually diminishing; the increase of subscription in 1908 was much to the benefit of the Society. In the Balance Sheet you will see that the assets of the Society exceed our liabilities by £125,516.

Mr. BURGESS expressed his pleasure that the Presidential Address had urged the more intense study of local geography, and hoped that the Society would make serious progress in this direction.

Captain SLACK asked that the Annual Report might be circulated in advance of the Meeting, and called attention to the fact that the announcements of the subject of Meetings during the last session had often been inconveniently late.

The PRESIDENT: It has always been the rule, I believe, to give the Report out at this meeting, but I will ascertain whether it is possible to publish it beforehand. As regards notice of the lectures this Session, I quite agree with Captain Slack that there has been a little delay; but there has been some difficulty in that owing to shortage of papers, an after-effect of the war, it has not been possible to fix the lectures very much in advance during the past Session.

We will now proceed with the election of officers and members of Council for the ensuing year. You have been kind enough to elect me for three successive years, and the time has come for the election of a successor. The Council have nominated for election by this meeting the Right Honourable the Earl of Ronaldshay. Lord Ronaldshay has travelled much in Central Asia, along the Indian Frontier, and in China; and, as you all know, he has recently returned from a very successful Governorship of Bengal. He is a man who goes very thoroughly indeed into whatever he takes up. I think it is very fortunate for us that he consented to be nominated for election at this meeting, and I am sure you will honour him by electing him to-day, confident that he will conduct your affairs with that same thoroughness that he has put into everything he has done.

New members proposed for election to the Council are Sir Charles Des Graz, a distinguished diplomatist who has travelled in a great many parts of the world and up to last year was our Minister in Belgrade. Sir Henry Galway has travelled much in West Africa, has taken much interest in geographical affairs, and has been Governor of South Australia. Colonel Howard-Bury I have already spoken of. Then we felt very anxious to have on the Council one or two naval officers. Years ago there always used to be naval officers on the Council, and ever since I have been President I have tried to get them on again, but have been unfortunate. As soon as Admiral Browning was elected the Admiralty transferred him from London to Devonport, so that he was not

able to attend and had to resign. Then much to our sorrow Lord Milford Haven, whom we elected last year, died during the autumn. This year we have nominated Admiral Sir Edward Inglefield, who is the Secretary of Lloyd's, and who has taken a great interest in our affairs; and Captain Royds, who was the colleague of Captain Scott in his first Expedition to the Antarctic. Mr. Wollaston you all know as the naturalist to the Mount Everest Expedition, and before that he travelled very extensively in New Guinea and in Africa. Lastly, there is Mr. J. M. Wordie, who was the geologist to Shackleton's Weddell Sea Expedition, and has explored Spitsbergen and other parts of the Arctic. Some of these are younger men than we generally elect, and we think it well that that should be so.

The Meeting proceeded to the election by ballot of the President and Council for the ensuing year, and the Scrutineers announced that the names proposed by the Council had been unanimously accepted by the Meeting (see List, p. ix).

Colonel Sir CHARLES CLOSE: I ask your permission to propose a hearty vote of thanks to the outgoing President, Sir Francis Younghusband. He has done admirable work for the Society during the past two and a half years; not three years, because as a fact the President does not leave until next November; he has six months' more life. We are very grateful to him for all he has done, and shall always remember his Presidency, first of all on account of his encouragement of the study and appreciation of natural beauty, which is a thing that all explorers ought to bear in mind—too often they bring back mere statistical accounts of a country—secondly, for his successful initiation of the Mount Everest Expedition. Before the President sat down, he expressed the hope that he had carried out his duties to the satisfaction of the Society. I am sure you will say that he has done so.

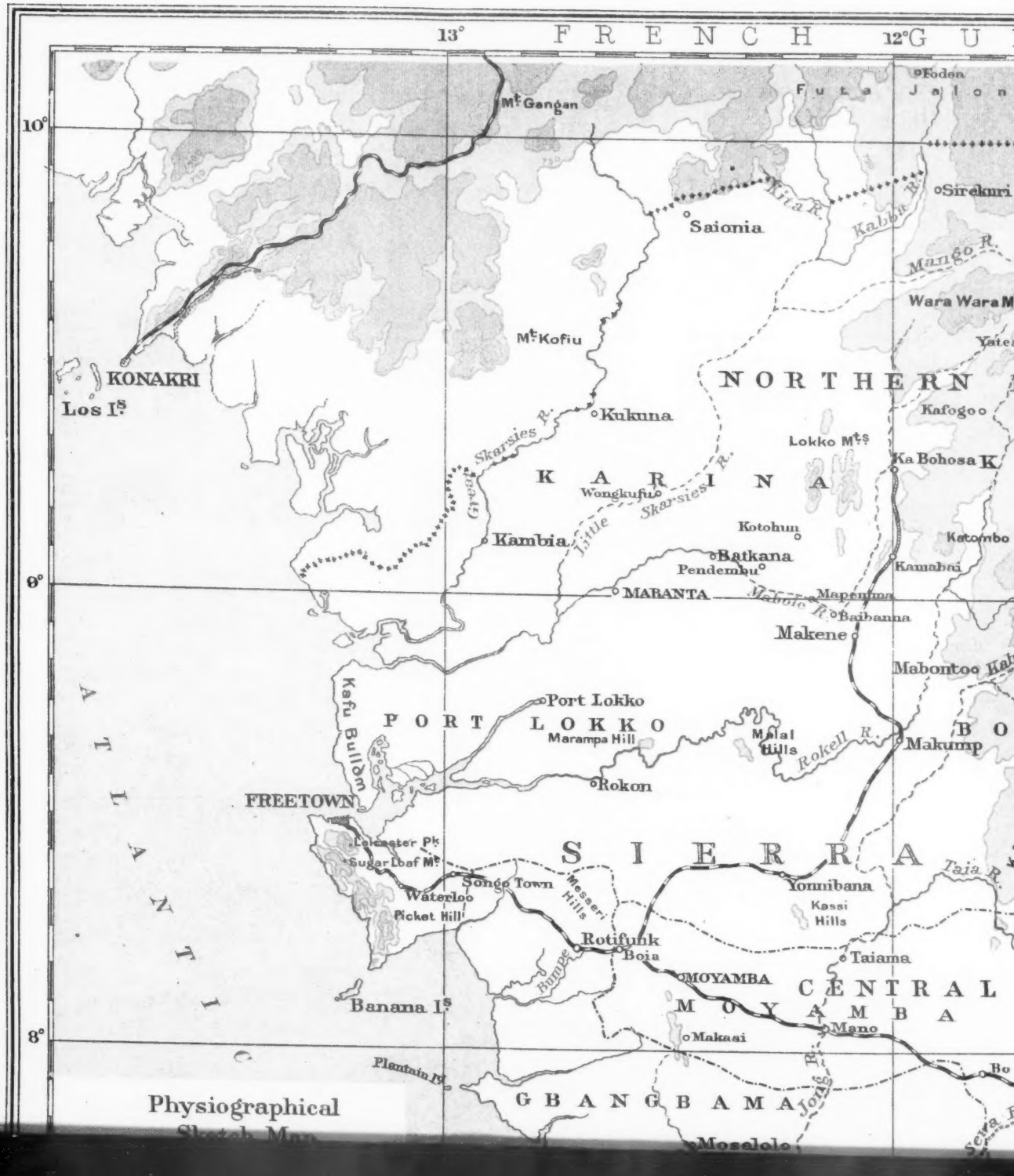
The Vote of Thanks having been carried by acclamation,

The PRESIDENT: Thank you very much indeed, Sir Charles Close, and you, ladies and gentlemen, for your very kind support of me. It has been a great pleasure and honour to preside over the meetings of the Society, and it is a satisfaction to me to know I have your approval.

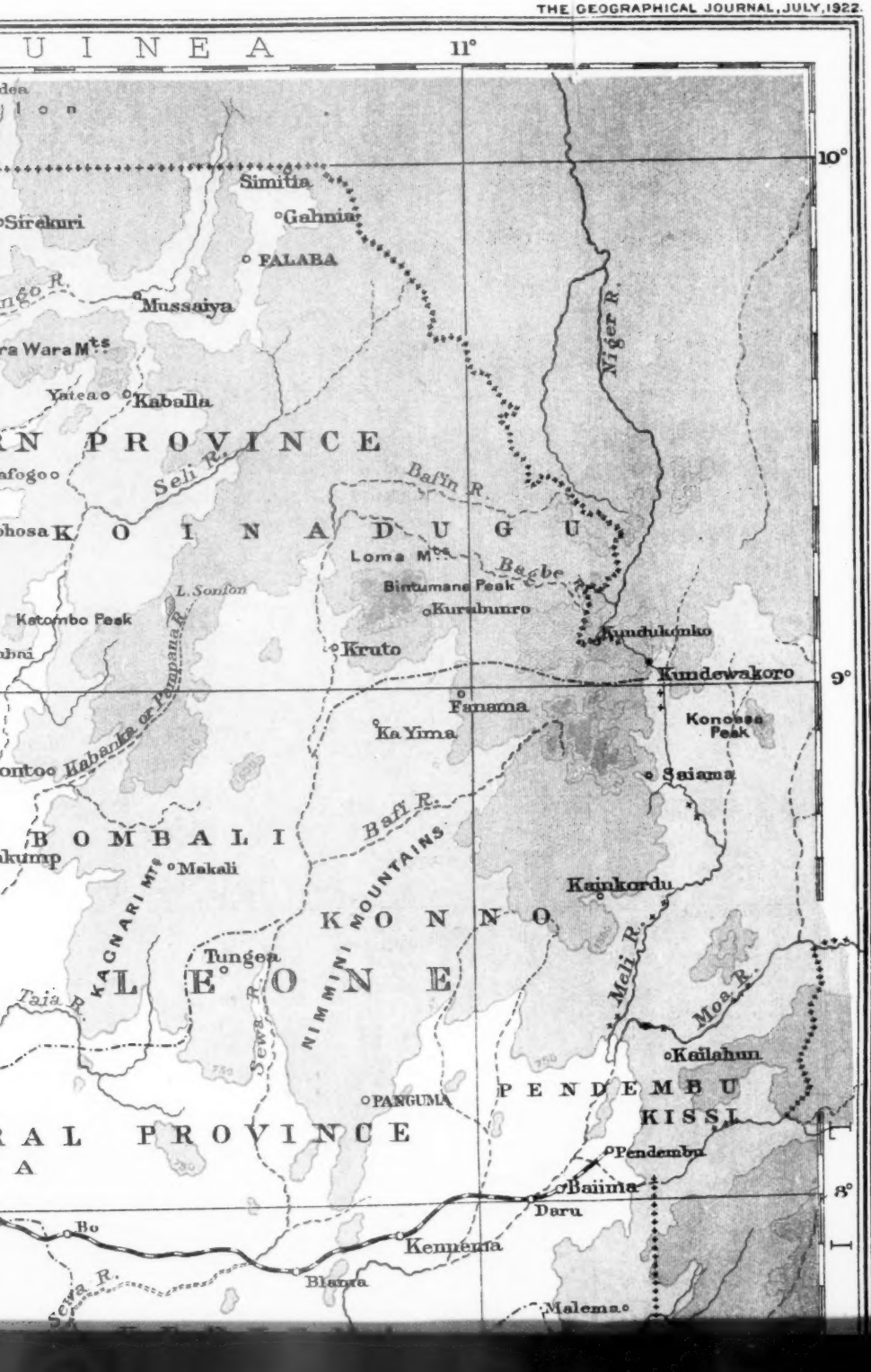
Fifteenth Evening Meeting, 12 June 1922.—The President in the Chair.

ELECTIONS.—Rev. Edward Batt Backhouse; Sir Stanley Lockhart Batchelor; Major John Forin Campbell: Cuthbert Collingwood, A.M.INST.C.E.; Mrs. Tucker Skipwith Coles; William Darwin; Captain Gerald Anthony Debenham, D.S.O., M.C.; Ernest Celestine Edwards; Lieut.-Col. A. C. Garner, D.S.O.; Grey Hesilrige; Captain F. C. de L. Kirk; Charles Lathrop Pack; F. H. Kitto; William H. Plummer; Rev. John Robbins; Lieut.-Col. Stephen Hungerford Pollen, C.M.G.; Bernard C. Dudley Ryder; Lieut.-Col. G. Taylor, D.S.O., R.F.A.; J. W. Waldron.

PAPER: The Present State of Abyssinia. C. F. Rey.



Physiographical
Sketch Map


U I N E A
11°
10°
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Simitia
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Sirekuri
FALABA
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Niger R.
Yatea
Kaballa
N PROVINCE
Seli R.
Bafin R.
K O I N A D U G U
Loma Mts.
Bagbe R.
Bintumani Peak
Kurabunro
L. Sonfon
Katombo Peak
Kruto
Kundukonko
Kundewakoro
Fanama
Ka Yima
Konossa Peak
Saiama
Kabanka or Pampana R.
B O M B A L I
Bafi R.
Makali
KAGNARI Mts
NIMMINI MOUNTAINS
Kainkordu
K O N N O
Tungea
L E O N E
Taia R.
Sewa R.
Meli R.
Moa R.
Kailahun
PANGUMA
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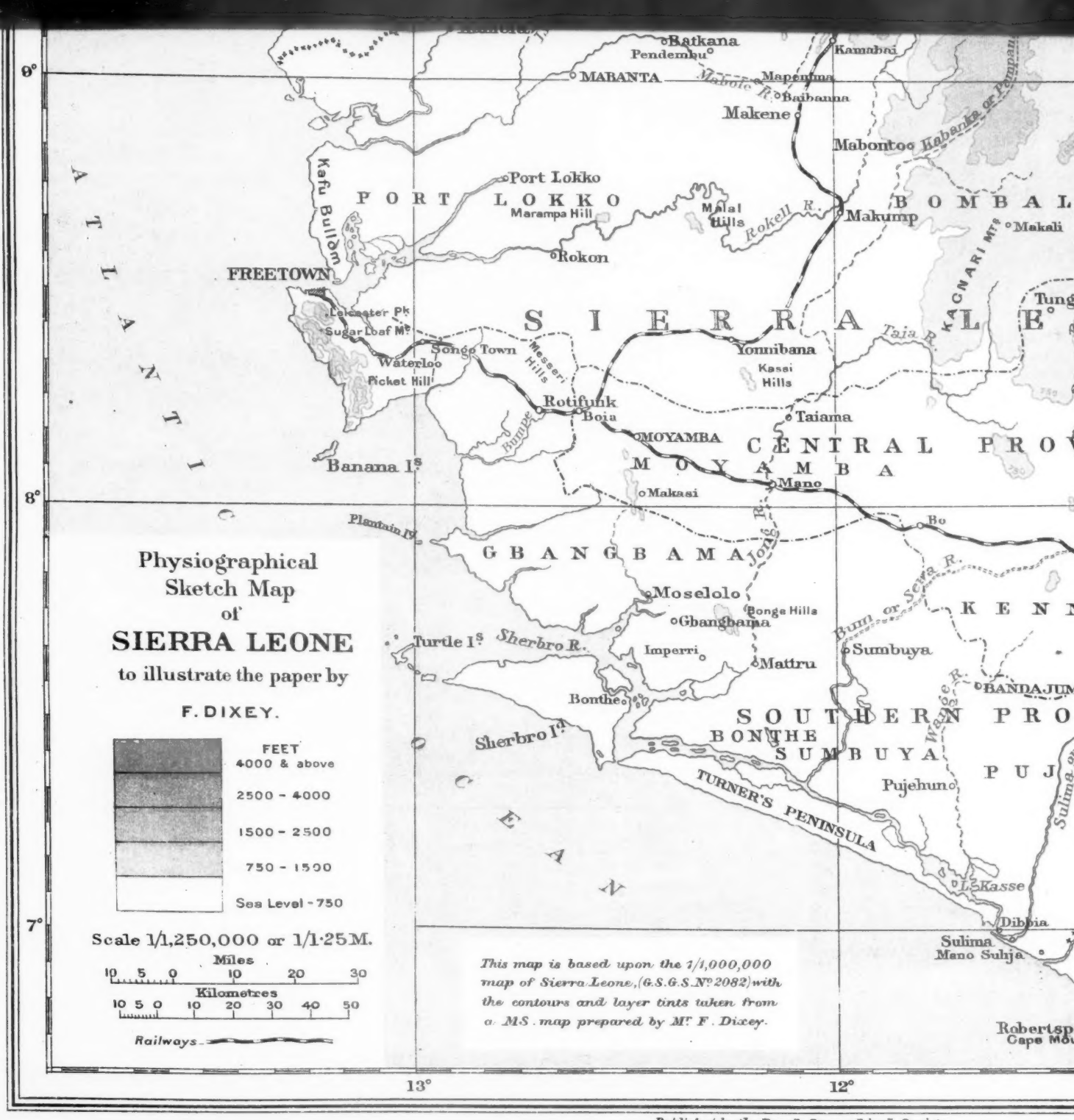

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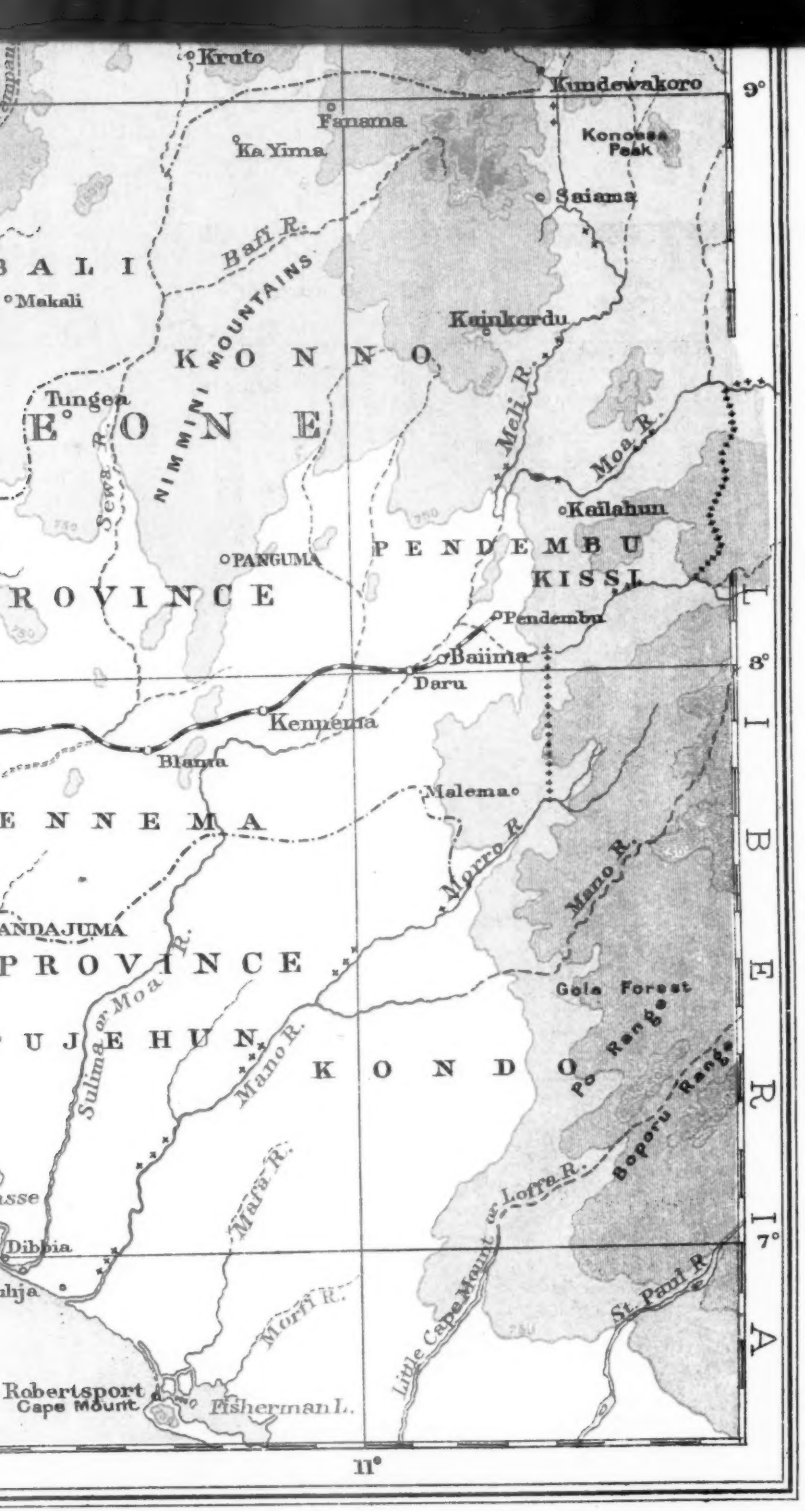

SIERRA LEONE
Dixey.